SCS ENGINEERS

MATERIAL RECOVERY FACILITY FEASIBILITY STUDY

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Prepared for:

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October 29, 1992
File No. 10-92010

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INTRODUCTION

The County of Santa Cruz (County) contracted with SCS Engineers to conduct an engineering feasibility study for a solid waste material recovery facility (MRF). The MRF was to receive and process municipal solid waste (MSW) from the City of Nogales and the surrounding County. To conduct this feasibility study, the following scope of services was performed:

- A waste sort was performed at the landfill. The information from the waste sort detailed the types and amounts of specific constituents of the waste stream from the City of Nogales and the surrounding areas. Based on this information, conceptual process system and facility designs were prepared.

- Based on a review of the area, a site located across the service road from the landfill was selected as a suitable potential site for a MRF. Based on this location, a facility arrangement was developed, and site and facility drawings are included in this study. The drawings provided the basis for the financial analysis of the project.

- As a result of developing conceptual process and facility arrangement drawings, sufficient information was obtained to provide a financial analysis. Capital and operating costs and the estimated tip fee (cost per ton) that would be required at the facility were estimated. A capital cost of $2,124,000 was estimated. An estimated tip fee of $49 per ton will be required to pay for the capital and operating costs of the facility. These costs were compared to similar projects and the national averages and found to be reasonable and appropriate. The facility cost analysis included an evaluation of the related market value of recyclable materials in the waste stream.

- A review of pertinent environmental factors showed no fatal flaws associated with the site potentially selected for the MRF.

- An analysis of MRF procurement options was developed to assist the County in deciding what method(s) of procurement might be most appropriate. These options are reviewed with regard to the MRF conceptual design in conjunction with the County's ability to own and operate the facility. As a result of this analysis, the recommended procurement and ownership option is for County to own and operate the facility. The recommended option includes utilizing two primary contractors (one building contractor and one equipment contractor). It is estimated that from initiation of the design project to facility start-up would take approximately 2 years. If fast-track implementation were incorporated into the process, the time frame could be shortened by as much as 1 year.

SUMMARY OF RESULTS

The feasibility of a MRF must be measured by considering a number of different factors. First, it must be determined if the MRF would satisfy the goals of the County. If the MRF does satisfy the goals of the County, other feasibility factors must be considered, including:

- Cost per ton to process waste compared to tipping fees at area landfills.
- Environmental impacts and liability.
- Control of waste and related costs.
- State recycling mandates.
- Longterm cost and environmental viability.
- Future legislative and regulatory considerations.

The results of this analysis show that a MRF could be anticipated to reduce the amount of MSW currently being landfilled by approximately 23 percent. If a composting program were initiated for the compostable fraction of the MSW, the amount of material disposed at the landfill could potentially be reduced by approximately 47 percent of the waste stream. Because of the produce industry in the area, certainly composting source separated produce should be considered as a highly effective method of reducing the amount of material disposed at the landfill. Regardless, a MRF in this area could have a significant impact related to extending the life of the existing landfill.

Extending the life of the landfill can have a significant impact on overall solid waste management costs. The cost per ton to process waste in this MRF feasibility study is obviously greater than the existing cost of landfilling. However, if the landfill reaches capacity sooner than anticipated, the cost of siting, permitting and designing a landfill will result in a significantly higher cost factor.

As solid waste disposal options are compared, the operation of a MRF typically appears more expensive than landfilling. The additional expense results from the cost of processing waste and having to landfill whatever waste cannot be recycled or composted. The cost avoidance (or savings) results from removing the recyclable and/or compostable material from the waste stream. Stated differently, you save money by reducing the amount of material requiring landfill disposal. This starts with removing the recyclable material and could include removal of the compostable fraction.

After evaluating the conditions surrounding the Santa Cruz County landfill, extending the life of the landfill should be of paramount importance. Significant life extension of the landfill can be accomplished by diverting the recyclables from the landfill. By constructing and operating a MRF, the recyclables can be removed and the compostable fraction of the MSW could possibly be composted. The costs associated with these options are reasonable when compared to current landfilling costs in the area.

It is anticipated that legislative and regulatory requirements will continue to cause the costs of landfills and resultant tip fees to increase faster than those associated with MRFs. Therefore, it appears that a MRF is a reasonable solid waste management option for Santa Cruz County. In addition, the composting options should also be explored in greater detail.

SECTION 1

WASTE STREAM CHARACTERIZATION

INTRODUCTION

The foundation for determining the feasibility of a Solid Waste Processing Facility requires a relatively detailed knowledge of the applicable waste stream characteristics. This project is bound by the character and quantity of the municipal solid waste stream for the County of Santa Cruz.

The waste stream characteristics were obtained during a 2-day physical waste sort at the Rio Rico Landfill that included sorting and weighing 20 representative samples of City waste. In addition, visual waste characterization was conducted for other self-haul vehicles that were thought to be mainly residential waste. This data is displayed in tabular form at the end of this section and summarized under Collected and Calculated Data Summary. Although the impact of the produce industry was not included in the data collection work. However, from a review of landfill records it was estimated that from November through May, spoiled produce accounts for an average of 11 tons per day of additional material that is disposed at the landfill.

A specific Sampling Procedures Work Plan was developed that presents the sorting protocols and methodologies utilized in the sampling program. This work plan is presented below. Certain modifications to this work plan were required to comply with site constraints and equipment availability.

The waste was divided into specific categories as indicated in the Sampling Procedures Work Plan. This information was further refined into both Waste Composition spreadsheets that define the processing capacity requirements for recovery of recyclable materials and the compostable fraction of the material.

Tables 1-1 through 1-6, at the end of Section 1, present the information collected and analyzed. These tables divide the waste characterization data into estimated quantities of residential, commercial, and visually characterized (primarily residential) wastes. The results are summarized in the following Table 1:

TABLE 1
SUMMARY OF WASTE CHARACTERIZATION INFORMATION

CONTRIBUTOR	Sorted waste (Res. & Com.)	Visual Char. Data	Total Composite	Typical MSW Char. *
CONSTITUENT	AVG. %	AVG. %	AVG. %	AVG. %
PAPER	39.4%	8.7%	29.2%	41.1%
PLASTICS	11.6%	0.4%	7.9%	6.5%
YARD WASTE	7.5%	18.3%	11.1%	17.9%
ORGANIC WASTE	30%	29.7%	29.8%	7.9%
GLASS	3.4%	0%	2.3%	8.2%
METALS	5.4%	9.4%	6.7%	8.7%
INORGANICS	1.3%	17.1%	6.6%	1.6%
OTHER WASTE	1.4%	16.4%	6.4%	8.1%

* Decision Makers Guide to Solid Waste Management, United States Environmental Protection Agency, 1989.

SAMPLING PROCEDURES WORK PLAN

Introduction

The assembly of relevant, precise, and accurate data is a primary goal of any significant waste composition study. Thus, a comprehensive, carefully managed and thoroughly documented Field Sampling Procedures Work Plan is crucial.

The Work Plan outlined the sampling protocols and methodologies utilized to develop the Waste Characterization Data for the County. Field procedures outlined in this document were performed on July 29 and 30, 1992.

Purpose

The plan provided a reference guide detailing the solid waste sorting and weighing procedures employed during the Waste Composition Study of the residential and commercial waste at the landfill. The plan served as the technical reference utilized during the study and the development of the project's subsequent data. In addition, procedures relevant to field activities were addressed in this document.

The waste characterization program involved sorting solid waste into predesignated categories. The basic procedures to accomplish this objective are presented with standard forms used for recording data recovered in the field activities.

The field sampling program included refuse characterization from both the urban and rural areas of the County. Field procedures are presented separately in the Manual Classification Program portion of this section.

Ensuring adherence to procedures during field activities was the responsibility of the SCS Engineers (SCS) Site Manager. The Site Manager was intimately familiar with the project's scope and requirements, and directed field operations as necessary to comply with the project requirements. The Site Manager was responsible for:

- Assuring that the appropriate procedures were available and properly implemented by all sampling personnel.
- Assuring that personnel were aware of the provisions of the plan and were instructed in the work practice necessary to comply with the relevant procedures.
- Assuring that personnel were aware of any potential deviations from described procedures.
- Supervising the monitoring of procedural compliance by personnel to ensure that the required work practices were employed.
- Correcting any procedure that could result in inaccurate or imprecise data being included in the study.

Data Collection Forms

The following data collection forms (samples provided at the end of this section) were used:

- Vehicle Weight Data Form
- Waste Composition Study Data Log

Manual Classification Program

This section describes the procedures applicable to the sample acquisition, manual sorting, and weighing of the waste streams generated by the County and residential sectors in and around Nogales, Arizona.

Sample Acquisition --

The sampling program was based on the systematic random selection of incoming refuse vehicles. The refuse received from the City of Nogales transfer vehicles, private contractor collection vehicles and the night time drop off box were targeted for sampling. This was done to collect data on the constituents of the waste generated from the consistent generators that would contain recyclable materials. Also, these generators typically provide a majority of the

total waste to the landfill. In addition, a visual characterization was also performed on other vehicles entering the facility from the County. This was done because it became apparent that a significant amount of waste was being disposed of by other haulers. These other haulers include the Produce Industry. The produce industry reportedly doubles the amount of waste disposed of at the landfill during the months of November through April.

Selected vehicles containing residential refuse were diverted to the sort site. Upon entering the site, every refuse vehicle driver was interviewed to ascertain various load source data as described below:

Date: Date of Interview.

Time: Time of Interview.

Truck I.D.#: The vehicle number unique to the truck being interviewed.

Waste Type: City of Nogales - Residential.

Hauler: Hauler name.

Truck Type: Select appropriate category from given menu.

Load Weight: Scale tickets were examined to determine the net vehicle load weight. (None was available because no scale weights were provided).

Truck Volume: An estimate of the compacted volume capacity.

Comments: Any comment or observation by the interviewer or driver relevant to the integrity of the above data.

Recorded by: Site Manager's name.

This information, together with other pertinent facts regarding the load source, were recorded by the Site Manager onto the Vehicle Weight Data Form. The vehicle was then processed according to procedures outlined below. A front-end loader was used to obtain a representative 200 to 300 pound sample of refuse for subsequent sorting as follows:

1) The refuse vehicle was unloaded at the pre-designated area identified by the Site Manager. This area provided sufficient room to allow the front-end loader to grab refuse from any area on the pile.

2) At the direction of the Site Manager, the front-end loader drove into the refuse pile, grabbing a sample on one side of the load.

3) The front-end loader carried the sample to the area immediately in front of the designated sort crew and deposited it onto a tarp.

4) Step 2 was repeated making sure that a sample was taken from a different area of the load. Every effort was made to sample as large and diverse an area of the load as possible, recognizing limitations in the required number of samples and load size.

Refuse Classification--

This procedure details the appropriate field activities utilized to classify waste components received from residential loads. The equipment for the refuse classification program consisted of the following:

- Sorting box: A plywood box constructed (6 ft x 3 ft x 1.5 ft deep) with carrying handles.
- Two scales: The scales had a range of 0 to 100 pounds and were accurate to $\pm$ 1 pound.
- Twenty plastic containers: These served as containers for the waste sort categories and their capacity was approximately 30 gallons.
- Shovel and push broom: Self-explanatory.
- Four polypropylene tarps: Tarps were approximately 10 feet to 15 feet square, and were capable of holding a 250 pound load of refuse.

Together with the appropriate personal protection (e.g., face masks, double lined gloves, work boots, rubber or canvas aprons), this equipment was sufficient to meet the needs of one sort crew. The distribution of category containers around the sort box was altered at the discretion of the Site Manager.

Sorting activities proceeded as follows:

- Large or heavy waste items, such as bags of yard waste, were torn open, examined, and then placed directly into the appropriate category container for subsequent weighing.
- The sample was then transferred, item by item, to the sort box until the box was full.
- Plastic bags of waste were opened and sort crew members manually segregated each item of waste according to the sort category list and placed it in the appropriate category container.
- At the completion of sorting, the category containers were moved to the scale where the crew leader weighed each container and recorded this scale reading, less the container's tare weight, on the Waste Composition Study Data Log sheet that was generated for every sample. Information detailing the sample source was transcribed to the Data Log from the Vehicle Weight Data Form completed at the initial interview. The level of precision on weight readings was to the nearest 1 pound.

- After each container was weighed, it was then carried to a designated area to be emptied.

This procedure was repeated for 10 samples per day per crew during the 2-day sampling event.

COLLECTED AND CALCULATED DATA SUMMARY

The data collected from the 2-day waste sort has been summarized for review in the following tables. The tables include:

- Figure 1-1: Sampled Loads for Waste Composition Study
- Figure 1-2: Santa Cruz County Waste Composition Study Aggregate Waste Composition
- Figure 1-3: Santa Cruz County Waste Composition Study Estimated Commercial Waste Composition
- Figure 1-4: Santa Cruz County Waste Composition Study Estimated Residential Waste Composition
- Figure 1-5: Santa Cruz County Waste Composition Study Estimated Waste Composition Summary Data
- Figure 1-6: Santa Cruz County Waste Composition Study Volume Visual Characterization Data
- Waste Characterization Study Sort Category Descriptions

FIGURE 1–1
SAMPLED LOADS (MANUALLY SORTED) FOR WASTE COMPOSITION STUDY
SANTA CRUZ COUNTY, ARIZONA

DATE	HAULER	LOAD NUMBER	SAMPLE NUMBER	VEHICLE TYPE	LOAD GENERATORS
29–Jul–92	CITY OF NOGALES	1	29–01–01	TRAILER	Unknown – predominantly commercial refuse
"	"	"	29–01–02	"	"
"		"	29–01–03	"	"
"	"	"	29–01–05	"	"
"	"	"	29–01–06	"	"
"	CANYON DISPOSAL	2	29–02–04	REAR	"
"	CITY OF NOGALES	3	29–03–07	TRAILER	"
"	"	"	29–03–08	"	"
"	"	"	29–03–09	"	"
"	"	"	29–03–10	"	"
30–Jul–92	CITY OF NOGALES	1	30–01–01	DUMP	Night time drop–box at landfill
"	CITY OF NOGALES	2	30–02–02	TRAILER	Unknown – predominantly residential refuse
"	"	"	30–02–03	"	"
"	"	"	30–02–05	"	"
"	CANYON DISPOSAL	3	30–03–04	REAR	Rio Rico & Firestone Garden
"	CITY OF NOGALES	4	30–04–06	TRAILER	Unknown – predominantly residential refuse
"	"	"	30–04–07	"	"
"	"	"	30–04–08	"	"
"	"	"	30–04–09	"	"
"	"	"	30–04–10	"	"

FIGURE 1-2
SANTA CRUZ COUNTY WASTE COMPOSITION STUDY
AGGREGATE WASTE COMPOSITION

		MEAN (%)	STD. DEV. (%)	LOWER CONFIDENCE INTERVAL (%)	UPPER CONFIDENCE INTERVAL (%)
PAPER					
	Newsprint	3.8%	5.4%	1.4%	6.1%
	Corrugated/Kraft	19.5%	15.3%	12.8%	26.3%
	Magazines/Glossy	1.0%	1.4%	0.4%	1.6%
	Office/Computer Paper	1.4%	3.9%	0.0%	3.1%
	Other Mixed Paper	13.7%	7.7%	10.3%	17.1%
	Total Paper	39.4%	12.8%	33.8%	45.1%
PLASTICS					
	PET Containers	0.6%	0.9%	0.2%	1.0%
	HDPE Containers	1.1%	0.8%	0.7%	1.4%
	Films/Bags	6.1%	3.1%	4.7%	7.4%
	Other Plastics	3.8%	4.9%	1.6%	5.9%
	Total Plastics	11.6%	6.1%	8.8%	14.2%
YARD WASTE					
	Misc. Yard Waste	7.5%	10.7%	2.8%	12.2%
	Total Yard Waste	7.5%	10.7%	2.8%	12.2%
ORGANICS					
	Wood/Lumber	3.4%	4.3%	1.5%	5.3%
	Textiles/Rubber/Leather	2.4%	2.5%	1.3%	3.5%
	Food Wastes	8.4%	6.0%	5.8%	11.1%
	Other Organics	15.8%	10.8%	11.1%	20.5%
	Total Organics	30.0%	14.9%	23.6%	36.7%
GLASS					
	Clear Glass Containers	2.4%	1.5%	1.7%	3.0%
	Green Glass Containers	0.1%	0.1%	0.0%	0.1%
	Brown Glass Containers	0.8%	0.9%	0.5%	1.2%
	Other Glass Containers	0.1%	0.1%	0.0%	0.1%
	Total Glass	3.4%	1.9%	2.5%	4.2%
METALS					
	Ferrous Containers (Tinned)	1.6%	0.9%	1.2%	2.1%
	Other Ferrous Metals	2.8%	3.5%	1.3%	4.4%
	Beverage Cans	0.7%	0.4%	0.5%	0.8%
	Non-Ferrous Metal	0.3%	0.4%	0.1%	0.4%
	Total Metals	5.4%	3.8%	3.8%	7.1%
INORGANICS					
	Misc. Inorganics	1.3%	4.2%	0.0%	3.1%
	Total Inorganics	1.3%	4.2%	0.0%	3.1%
OTHER WASTE					
	Tires	1.0%	4.7%	0.0%	3.1%
	HHW	0.4%	0.5%	0.1%	0.6%
	Total Other Waste	1.4%	4.6%	0.0%	3.4%
TOTAL SAMPLE		100.0%			

FIGURE 1-3
SANTA CRUZ COUNTY WASTE COMPOSITION STUDY
ESTIMATED COMMERCIAL WASTE COMPOSITION

		MEAN (%)	STD. DEV. (%)	LOWER CONFIDENCE INTERVAL (%)	UPPER CONFIDENCE INTERVAL (%)
PAPER					
	Newsprint	1.2%	1.2%	0.5%	2.0%
	Corrugated/Kraft	29.1%	15.8%	19.3%	38.9%
	Magazines/Glossy	0.3%	0.6%	0.0%	0.7%
	Office/Computer Paper	0.6%	1.1%	0.0%	1.2%
	Other Mixed Paper	15.5%	9.7%	9.5%	21.5%
	Total Paper	46.8%	13.9%	38.2%	55.4%
PLASTICS					
	PET Containers	0.2%	0.3%	0.0%	0.4%
	HDPE Containers	0.7%	0.5%	0.3%	1.0%
	Films/Bags	6.5%	4.2%	3.9%	9.1%
	Other Plastics	2.9%	3.0%	1.1%	4.7%
	Total Plastics	10.3%	5.6%	6.9%	13.8%
YARD WASTE					
	Misc. Yard Waste	10.8%	13.9%	2.2%	19.4%
	Total Yard Waste	10.8%	13.9%	2.2%	19.4%
ORGANICS					
	Wood/Lumber	4.3%	5.4%	0.9%	7.6%
	Textiles/Rubber/Leather	2.4%	3.1%	0.5%	4.3%
	Food Wastes	5.3%	5.0%	2.1%	8.4%
	Other Organics	10.6%	11.8%	3.3%	17.9%
	Total Organics	22.6%	16.0%	12.6%	32.4%
GLASS					
	Clear Glass Containers	1.6%	1.1%	0.9%	2.2%
	Green Glass Containers	0.0%	0.0%	0.0%	0.0%
	Brown Glass Containers	0.7%	0.8%	0.3%	1.2%
	Other Glass Containers	0.0%	0.0%	0.0%	0.0%
	Total Glass	2.3%	1.6%	1.3%	3.3%
METALS					
	Ferrous Containers (Tinned)	1.2%	0.9%	0.7%	1.8%
	Other Ferrous Metals	2.7%	3.5%	0.5%	4.9%
	Beverage Cans	0.5%	0.4%	0.3%	0.8%
	Non-Ferrous Metal	0.1%	0.1%	0.0%	0.1%
	Total Metals	4.6%	3.7%	2.2%	6.9%
INORGANICS					
	Misc. Inorganics	0.4%	0.7%	0.0%	0.8%
	Total Inorganics	0.4%	0.7%	0.0%	0.8%
OTHER WASTE					
	Tires	2.1%	6.6%	0.0%	6.2%
	HHW	0.2%	0.5%	0.0%	0.5%
	Total Other Waste	2.3%	6.5%	0.0%	6.4%
TOTAL SAMPLE		100.0%			

FIGURE 1-4
SANTA CRUZ COUNTY WASTE COMPOSITION STUDY
ESTIMATED RESIDENTIAL WASTE COMPOSITION

		MEAN (%)	STD. DEV. (%)	LOWER CONFIDENCE INTERVAL (%)	UPPER CONFIDENCE INTERVAL (%)
PAPER					
	Newsprint	6.3%	6.7%	2.2%	10.5%
	Corrugated/Kraft	10.0%	6.6%	5.9%	14.0%
	Magazines/Glossy	1.7%	1.7%	0.6%	2.7%
	Office/Computer Paper	2.2%	5.4%	0.0%	5.6%
	Other Mixed Paper	11.9%	5.1%	8.8%	15.1%
	Total Paper	32.1%	5.8%	28.5%	35.7%
PLASTICS					
	PET Containers	1.0%	1.1%	0.3%	1.7%
	HDPE Containers	1.5%	0.8%	1.0%	2.0%
	Films/Bags	5.6%	1.3%	4.8%	6.4%
	Other Plastics	4.6%	6.3%	0.7%	8.5%
	Total Plastics	12.7%	6.7%	8.6%	16.9%
YARD WASTE					
	Misc. Yard Waste	4.3%	4.9%	1.2%	7.3%
	Total Yard Waste	4.3%	4.9%	1.2%	7.3%
ORGANICS					
	Wood/Lumber	2.6%	3.0%	0.8%	4.4%
	Textiles/Rubber/Leather	2.4%	1.8%	1.3%	3.6%
	Food Wastes	11.6%	5.2%	8.4%	14.9%
	Other Organics	21.0%	6.7%	16.9%	25.2%
	Total Organics	37.6%	9.4%	31.9%	43.5%
GLASS					
	Clear Glass Containers	3.2%	1.4%	2.4%	4.1%
	Green Glass Containers	0.1%	0.2%	0.0%	0.2%
	Brown Glass Containers	0.9%	1.0%	0.3%	1.5%
	Other Glass Containers	0.2%	0.2%	0.0%	0.2%
	Total Glass	4.4%	1.7%	3.3%	5.4%
METALS					
	Ferrous Containers (Tinned)	2.0%	0.8%	1.6%	2.5%
	Other Ferrous Metals	3.0%	3.7%	0.7%	5.3%
	Beverage Cans	0.8%	0.4%	0.5%	1.0%
	Non-Ferrous Metal	0.5%	0.4%	0.2%	0.8%
	Total Metals	6.3%	3.8%	3.9%	8.6%
INORGANICS					
	Misc. Inorganics	2.2%	5.8%	0.0%	5.9%
	Total Inorganics	2.2%	5.8%	0.0%	5.9%
OTHER WASTE					
	Tires	0.0%	0.0%	0.0%	0.0%
	HHW	0.4%	0.6%	0.1%	0.8%
	Total Other Waste	0.4%	0.6%	0.1%	0.8%
TOTAL SAMPLE		100.0%			

FIGURE 1-5
SANTA CRUZ COUNTY WASTE COMPOSITION STUDY
ESTIMATED WASTE COMPOSITION SUMMARY DATA

	PERCENT COMPOSITION FROM MANUAL SORTING+			PERCENT COMPOSITION FROM VISUAL CHARACTERIZATION*	
	RESIDENTIAL (%)	COMMERCIAL (%)	AGGREGATE (%)		
PAPER				BAGGED WASTE	16.4%
Newsprint	6.3%	1.2%	3.8%	PAPER	
Corrugated/Kraft	10.0%	29.1%	19.5%		
Magazines/Glossy	1.7%	0.3%	1.0%	OCC	7.7%
Office/Computer Paper	2.2%	0.6%	1.4%	Other Mixed Paper	1.0%
Other Mixed Paper	11.9%	15.5%	13.7%		
Total Paper	32.1%	46.8%	39.4%	Total Paper	8.7%
PLASTICS				PLASTICS	
				Other Plastics	0.4%
PET Containers	1.0%	0.2%	0.6%		
HDPE Containers	1.5%	0.7%	1.1%	Total Plastics	0.4%
Films/Bags	5.6%	6.5%	6.1%		
Other Plastics	4.6%	2.9%	3.8%	YARD WASTE	
Total Plastics	12.7%	10.3%	11.6%	Misc. Yard Waste	18.3%
YARD WASTE				Total Yard Waste	18.3%
Misc. Yard Waste	4.3%	10.8%	7.5%	ORGANICS	
Total Yard Waste	4.3%	10.8%	7.5%	Wood	7.1%
ORGANICS				Textiles	1.3%
				Food Wastes	21.3%
Wood/Lumber	2.6%	4.3%	3.4%	Total Organics	29.7%
Textiles/Rubber/Leather	2.4%	2.4%	2.4%		
Food Wastes	11.6%	5.3%	8.4%	GLASS	
Other Organics	21.0%	10.6%	15.8%		
Total Organics	37.6%	22.6%	30.0%	Total Glass	0.0%
GLASS				METALS	
				Other Ferrous Metal	7.5%
Clear Glass Containers	3.2%	1.6%	2.4%	Non-Ferrous Metal	1.9%
Green Glass Containers	0.1%	0.0%	0.1%		
Brown Glass Containers	0.9%	0.7%	0.8%	Total Metals	9.4%
Other Glass	0.2%	0.0%	0.1%		
Total Glass	4.4%	2.3%	3.4%	INORGANICS	
METALS				Dry Wall	10.4%
				Masonry	1.0%
Ferrous Containers (Tinned)	2.0%	1.2%	1.6%	Roofing Materials	5.8%
Other Ferrous Metal	3.0%	2.7%	2.8%		
Beverage Cans	0.8%	0.5%	0.7%	Total Inorganics	17.1%
Non-Ferrous Metal	0.5%	0.1%	0.3%		
Total Metals	6.3%	4.5%	5.4%	TOTAL	100.0%
INORGANICS					
Misc. Inorganics	2.2%	0.4%	1.3%		
Total Inorganics	2.2%	0.4%	1.3%		
OTHER WASTE					
Tires	0.0%	2.1%	1.0%		
HHW	0.4%	0.2%	0.4%		
Total Other Waste	0.4%	2.3%	1.4%		
TOTAL SAMPLE	100.0%	100.0%	100.0%		

NOTES

1. + All percentage compositions are percent by weight.
2. * All percentage compositions are percent by volume.

FIGURE 1-6
SANTA CRUZ WASTE COMPOSITION STUDY
VOLUME VISUAL CHARACTERIZATION DATA

COMPONENT	VOLUME CHARACTERIZED (cu. yds.)	PERCENT COMPOSITION FROM VISUAL CHARACTERIZATION*
BAGGED WASTE	89.5	16.4%
PAPER		
OCC	41.7	7.7%
Other Mixed Paper	5.5	1.0%
Total Paper	47.2	8.7%
PLASTICS		
Other Plastics	2.0	0.4%
Total Plastics	2.0	0.4%
YARD WASTE		
Misc. Yard Waste	99.5	18.3%
Total Yard Waste	99.5	18.3%
ORGANICS		
Wood	38.8	7.1%
Textiles	6.9	1.3%
Food Wastes	116.0	21.3%
Total Organics	161.7	29.7%
GLASS		
Total Glass	0.1	0.0%
METALS		
Other Ferrous Metal	40.9	7.5%
Non-Ferrous Metal	10.1	1.9%
Total Metals	51.0	9.4%
INORGANICS		
Dry Wall	57.4	10.4%
Masonry	5.2	1.0%
Roofing Materials	31.4	5.7%
Total Inorganics	94.0	17.1%
TOTAL	545.0	100.0%

NOTE:
1. Total of 119 vehicles characterized.

WASTE CHARACTERIZATION STUDY SORT CATEGORIES

Category	Description
Paper	
Newsprint	This component includes paper products printed on newsprint, with either black or colored ink. Local papers/regional publications (gazettes) and other newspapers were sorted into this category.
Corrugated Cardboard/ Kraft Paper	This component includes brown corrugated cardboard and brown kraft paper. Brown kraft paper is commonly used in grocery bags, lunch sacks and in agricultural product packaging. It is a tough brown wrap made from sulfate wood pulp. This material is primarily used in the construction of boxes (corrugated packaging).
Magazines/Gloss Paper	This component includes magazines and glossy paper. Glossy paper generally was composed of newspaper advertisement inserts.
Office/Computer Paper	This component includes primarily high grade white and computer paper, such as typing and copy paper, and outputs from printers that do not contain a carbon.
Mixed Paper	This component includes paper that is not included in the previously mentioned categories. Mixed Paper includes carbon paper, non-corrugated cardboard (chipboard), tissues, paper towels, napkins, paper plates, paper packaging, "junk mail", books, phone books, and file folders. Non-corrugated cardboard is frequently seen in the form of cereal and shoe boxes; wax or plastic-coated cardboard is also included.
Plastics	
HDPE Containers	This component includes high density polyethylene (HDPE) plastic rigid containers used in beverage containers (e.g., milk, water, cider), liquid laundry detergent bottles, and other liquid applications.
PET Containers	This component includes polyethylene terephthalate (PET) plastic soda bottles. Clear and green colored PET, were included in this category.
Films/Bags	This component generally includes film plastic, such as household plastic bags (e.g., trash and sandwich bags and plastic wrap), cigarette wrappers, and dry cleaning bags, Thin, as well as thick, film plastics (colored and clear), and other flexible sheet plastic resins were included in this category.

WASTE CHARACTERIZATION STUDY SORT CATEGORIES (continued)

Category	Description
Other Plastics	This component includes all plastic materials that are not included in the categories above. This includes primarily film plastic, polystyrene materials, and all remaining rigid plastic containers that are not HDPE or PET, including polyvinyl chloride (PVC) and polypropylene containers).
Yard Waste	
Misc. Yard Waste	This component includes lawn clippings, prunings, leaves and woody material.
Organics	
Wood/Lumber	This component includes all processed wood products such as plywood, trim, construction boards, and pressboard.
Textiles/Rubber/Leather	This component includes primarily carpeting, clothes, and shoes. Generally, any textile item, including contaminated rags, shirts, socks, underwear, pants, and bedding, are sorted into this category. Rubber items, including shoes, carpet padding (foam padding), and heater hoses are included, as well as leather items (e.g., shoes, belts, hand bags, etc.).
Food Waste	This component includes food related organic materials present in waste. Liquid food wastes, such as soda, were emptied from their containers into the food waste category before the containers were sorted into the appropriate category.
Other Organics	This component includes disposable diapers, which are manufactured using a combination of plastic (polypropylene) and paper. In addition, this category covers fine organic material left at the bottom of the sorting table once larger distinguishable materials have been sorted.
Glass	
Clear Glass Containers	This component includes clear food, beverage, and supply containers.
Green Glass Containers	This component includes food, beverage, and supply containers made of green glass.
Brown Glass Containers	This component includes food, beverage, and supply containers made of brown glass.

WASTE CHARACTERIZATION STUDY SORT CATEGORIES (continued)

Category	Description
Other Glass	This component covers glass materials not described by the first three glass categories, such as light bulbs and window panes.
Metals	
Ferrous Container, Tinned	This component includes tin-coated steel cans (e.g., those used for food products).
Other Ferrous Metal	This component includes miscellaneous cast iron, steel, or other ferrous metals.
Beverage Cans	This component is limited to aluminum beverage cans.
Non-ferrous Metal	This component includes miscellaneous non-ferrous metal such as aluminum foil and copper metal.
Inorganics	
Misc. Inorganics	This category covers other non-combustible materials, excluding Other Waste (as defined below). Materials present in this category primarily are home construction wastes, such as dry wall, rock, plaster, fiberglass insulation, ceramic tile flooring, and asphalt composite shingles.
Other Wastes	
Tires	This category is limited to tires.
Misc. HHW	This category includes hazardous materials including poisons, paint, solvents, fuel, dry batteries, syringes, and oil filters.

SECTION 2

WASTE GENERATIONS PROJECTIONS

INTRODUCTION

Included in this study was a projection of the quantities of municipal solid waste that could be anticipated by the County into the year 2020. These projections are a necessary part of the analysis required for determining the feasibility of a Solid Waste Processing Facility. Thus, determination of the amount of waste generated within a specific service area is essential. The waste for this service area is generated by two specific entities: the City of Nogales (City) and the County. An additional factor considered was the impact of the produce industry on disposal of spoiled produce.

TABULAR REPRESENTATIONS

Population data for the County were reviewed and incorporated into the projections. This information was provided by the Population Statistics Unit, Research Administration, Arizona Department of Economic Security. Represented in Table 2-1A is the projected population growth rate of the service area for the existing landfill. Although not all the population represented contributes directly to the county landfill, it is estimated that 82 percent of the population is located in and around the City of Nogales.

Essentially, changes in the population generally will correlate with corresponding changes in the overall generation of solid waste. The projected population increases from 1991 to the year 2030 are depicted in Table 2-1A. Therefore, as presented in Table 2-1B, the quantity of solid waste should increase at a corresponding rate to the projected population growth. Table 2-1B depicts the total projected tonnage anticipated for disposal at the county landfill based on the commercial and residential population. Table 2-1B does not include the impact of the produce and other seasonal industries that can significantly increase the amount of material disposed at the landfill. From a review of the records at the landfill, the seasonal and produce industries can increase the amount of refuse disposed of at the landfill ranges from 25 to 75 tons per week during the months of November to May. Although some waste stream reduction on a per capita basis may occur as a result of public participation in waste minimization and recycling efforts, this is typically not significant enough to warrant consideration in a facility and processing system design.

Table 2-1C projects the daily capacity of a material recovery facility that would serve the commercial and residential generators of the County and the surrounding population of the City of Nogales. It is based on the amount of waste that should be routed through a MRF and that would contain recyclables in a quantity that could be cost effectively recovered. Therefore, Table 2-1C does not include the impact of seasonal produce and commercial waste generators. Generators of spoiled produce, construction waste, and other low recyclable content waste should not be routed through a MRF. Elimination of these types of materials in the MRF will substantially reduce operational difficulties. Thus, pre-screening of this material at the entrance of the MRF should be provided. This type of material is often a good candidate for composting.

Composting source separated food waste and other organic materials has been successfully accomplished and should be considered for these materials. The information in Table 2-1C represents the projected design capacity of a MRF that would be required to the year 2020. Although the designed life expectancy of most material recovery facilities is typically 20 years, and major equipment replacement would be anticipated before 2020.

The material recovery facility is conceptually designed around a capacity of 75 tons per day. This capacity was selected from Table 2-1C. The actual design processing rate is based on several factors that include the estimated time necessary to bring a material recovery facility on line, projected tonnages that require processing during the life of the facility, and the ability to expand the facility.

The capacity of 75 tons per day is based on one 8 hour shift. If increases in waste input are significantly more than the tonnages that are listed, the extra incoming waste can easily be processed through the addition of another shift. If the volume of waste is less than projected, the facility would still be operating at 85 to 100 percent capacity during the one 8 hour shift. In addition, room for expansions has been conceptually designed into the facility. This includes the possibility for the addition of a second processing line. Therefore, it is possible for the material recovery facility to quadruple its throughput with the addition of a second processing line and two shifts.

The capacity of a compost facility would also need to be designed to provide for the receiving, grinding, shredding and screening of approximately 75 tons per day in one eight hour period. This level of processing capacity would be required even though this waste is seasonal because this type of material cannot be successfully stored. Additional opportunities could exist in the composting operations that would include mixing the compostable fraction of the MSW waste stream with this spoiled produce.

FIGURE 2–1A
COUNTY OF SANTA CRUZ MATERIAL RECOVERY FEASIBILITY STUDY
SERVICE AREA PROJECTED POPULATION AND GROWTH RATES

	GROWTH		GROWTH		GROWTH		GROWTH		GROWTH		GROWTH	
1991	%	1992	%	1995	%	2000	%	2010	%	2020	%	2030
30,950	3.5%	32,025	10.4%	35,350	16.7%	41,250	31.8%	54,350	26.9%	68,975	22.9%	84,750

FIGURE 2–1B
SERVICE AREA PROJECTED SOLID WASTE (tons) – BASED ON POPULATION GROWTH

1991	1992	1995	2000	2010	2020	2030
16,584	17,160	18,942	22,103	29,122	36,959	45,412

FIGURE 2–1C
MATERIAL RECOVERY FACILITY CAPACITY (tpd) – PROJECTIONS BASED ON POPULATION GROWTH

1991	1992	1995	2000	2010	2020	2030
64	66	73	85	112	142	175

SECTION 3

ENVIRONMENTAL ISSUES

INTRODUCTION

When considering any alternative method of solid waste handling and disposal, the environmental impact must be fully evaluated. Certainly, identification of environmental factors is essential, and it must be recognized that all methods of solid waste handling inherently have environmental challenges and risks that must be addressed. The idea is to understand those challenges and risks, and minimize them to the fullest extent possible.

ENVIRONMENTAL REGULATIONS

A review of the environmental regulations and factors that would impact the permitting, construction, and operation of a material recovery was performed. Obviously, the potential site of a MRF has a significant impact on specific challenges to regulatory requirements. For this project, a potential site was selected as indicated on the conceptual design drawings in Section 4. However, some of the discussion involving this site could be applicable to other locations.

Initially, this particular location appears to be suitable for use as a MRF for several reasons, which include: the same truck routing; proximity to the existing landfill; minimization of final reject disposal costs due to its location adjacent to the existing landfill. Being adjacent to the existing landfill minimizes many siting considerations, if the landfill is not under scrutiny or pressure to be closed, or has an unfavorable environmental history.

From a preliminary review of the area depicted on the site drawing, there existed no apparent "fatal flaw" regarding environmental issues. At the MRF site, challenges related to storm water control, general public security, visual screening, and traffic control, all of which are typically primary factors in the permitting process, can be properly handled as indicated in the drawings. In addition, these locations already have good access to required utilities. Utility connections can be made at minimal cost.

With regard to the definition of MRFs, transfer stations, and composting facilities, they are all considered solid waste processing facilities. Therefore, they are required to comply with THE ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY OFFICE OF WASTE PROGRAMS SOLID WASTE UNIT - Waste Management Guidelines. These regulations are continually being reviewed and re-interpreted by the Arizona Department of Environmental Quality (ADEQ) on an ongoing basis. Therefore, it is important to maintain contact with the ADEQ pertaining to how any new regulations will affect construction, operation, design, or permit conditions. It is inherent that regulatory contacts be maintained to insure compliance with existing regulations or those being promulgated.

Operational standards for solid waste processing facilities require specific practices to ensure the health, safety, and aesthetic aspects of facilities are adequately addressed and maintained. A summary of specific criteria that must be addressed in the design and operation of these facilities include:

- Management and control of windblown material. This is managed with a fenced lot and allowances for litter control utilizing personnel for cleanup. In addition, an enclosed tipping floor minimizes the potential for windblown material.

- Methods of excluding industrial waste from disposal. Industrial waste shall not be received and processed at these facilities. This is a typical requirement for MSW processing facilities. Provisions for handling "Hot Loads" and contaminated loads are addressed in the permit documents and operating procedures.

- Methods for the management and control of special waste shall be identified.

- Consideration of easement protection and boundary buffer zones shall be addressed.

- Methods of facility screening must be depicted and maintained. As indicated in the cost estimates and the conceptual site plan, screening with landscaping and fencing is part of a facility design.

- Consideration of site access roadways, maintenance, and dust control must be addressed.

- Worker health and safety, specifically pertaining to ergonomics, air quality, safety procedures, and educational training must be addressed.

- Storm water management and control must be addressed. These facilities will be required to have a storm water discharge permit.

- Odor and air pollution must be addressed. These facilities must comply with regulations concerning air pollution control.

- Plans and procedures for preventing facility overloading must be developed.

- Alternate methods of disposal in the event of facility breakdowns must be determined.

- Methods of managing sanitation and vector related problems must be identified and approved.

- Methods of management and operations related to fire protection must be identified.

- Development and utilization of customized record keeping and reporting forms and information regarding facility operations must be provided.

COMPOSTING FACILITIES

The environmental concerns, as with a MRF, must also be addressed for composting facility. The control and minimization of odors are essential to public acceptance of a composting facility. The challenge with odors at a composting facility is to keep the process aerobic, and to prevent the process from going anaerobic. Proper control of odors may require high technology systems or in-vessel type processing. Videotapes of indoor type composting operations are available. Composting technology is available to reduce the organic fraction contained in the waste received at the facility. Introduction of this organic fraction from the MRF could significantly increase the contaminant load in the compost product, and would necessitate significantly more analytical testing of the finished product.

As with the MRF site reviewed, there was no apparent "fatal flaw" environmental issues identified in locating a composting facility adjacent to the MRF as indicated on the conceptual design drawings. The conceptual design of the MRF was developed based upon an organics reject fraction that could be composted. The intent is that at some point, this organic fraction could be introduced to yard waste, source separated food wastes, or other compostable materials.

Based on the fact that a comparatively large volume of organic waste is generated in the area, composting source separated spoiled produce would reduce the total amount of waste disposed in that landfill significantly. In addition, the compost from these type of materials can be of high quality and thus can be used in a variety of applications.

SECTION 4

DESIGN CONSIDERATIONS OF MATERIAL RECOVERY FACILITIES

INTRODUCTION

Information obtained from the waste sort performed at the landfill was used to develop a Waste Composition Summary for the material recovery facility. The waste sort information provides some of the specific data with regard to design considerations of a material recovery facility. Separate Waste Composition Summary tables were developed for both the manually sorted and visually classified material during the waste sort (Waste Composition Summary Tables 4-1 and 4-2, respectively). In addition, a composite weighted Waste Composition Summary was developed (Waste Composition Summary Table 4-3). Using this format, calculations on the operational costs and other related facility requirements are developed. The Waste Composition Summary tables are included at the end of this section.

The proposed conceptual MRF design presented in this study could be utilized as the basis for a final design to process the municipal solid waste stream in Santa Cruz County. During the preparation of the conceptual design and cost estimates, several specific considerations were addressed. These considerations included the following:

- Facility size and throughput considerations.
- Impacts related to public access and security features.
- Management, handling, and costs associated with special waste disposal.
- Description of processing operations.
- Personnel training.
- Conceptual facility process system layouts.
- Environmental regulations.
- Facility operational features.

FACILITY SIZE AND THROUGHPUT CONSIDERATIONS

The processing system for the MRF depicted in the conceptual design layout consists of proven and reliable technology. Although differences in MRF process system technology do exist, the logic related to facility throughput performance and capacity is similar. A MRF's size and processing capacity is directly related to the design layout and the recovery rates of personnel and the equipment selected. Determining the limiting component of the process system will reveal the actual processing system capacity.

MRFs are normally designed and rated on what they can process in one 8 hour shift. Misunderstandings of this concept have been a source of discrepancy in many proposals for packaged processing systems.

The arrangements illustrated in this design reflect an operating capacity of 75 tons per day. It should be noted that the facility throughput rate will vary based on the character of the waste received.

For example, some days the facility may process 75 tons per day, and other days, when the waste is highly contaminated with a particular constituent, may operate at a lower rate. The method of compensating for such variances is to extend the processing time. These facilities, although sized and designed for a specific average throughput waste stream composition, do not perform at a specific throughput rate day in and day out. In addition, the throughput rate of processing can be affected by a variety of external factors (e.g., rain, wind, holidays, seasonal changes in waste characterizations from tourists, employee performance, etc.).

Designing facility throughput based on processing the theoretical tonnage and waste stream is typically based on an 8 hour shift. The current tonnage throughput is typically selected as the required theoretical capacity. This provides latitude for growth and expansion of the system and efficient use of manpower for the operation. Facility capacity can be substantially increased just by adding a second shift without adding or changing equipment, or expanding the facility size.

The processing facility has been designed to handle approximately 75 tons per day (TPD). Based on population growth, the MRF processing capacity would need to be 112 TPD in the year 2010 and 142 TPD in 2020. Therefore, extended shifts or two shifts will enable the facility to accommodate the increased tonnage due to population growth without significant modification to the facility until after the year 2020. Processing equipment life is expected to be 20 years.

IMPACTS RELATED TO PUBLIC ACCESS AND SECURITY

Public access to the facility should be maintained by using a separate public recyclables drop-off area. The drop-off area will contain several containers that can be used for specific recyclables. The public will gain access to the drop-off area through a separate lane in the scale area. This will allow the scale clerk to monitor incoming and outgoing traffic.

Security considerations related to the construction of the MRF will consist of a 6 foot high chain link fence encompassing the site with access gained through chain link gates. During non-operational hours, the gates will be locked. Public access will only be allowed during operational hours. Tours of the facility will be by appointment only.

MANAGEMENT, HANDLING, AND COSTS ASSOCIATED WITH SPECIAL WASTE DISPOSAL

Specific considerations are required for management of special waste disposal. A primary consideration is public education and awareness of what types of waste require special handling and disposal. Examples of public education programs include voluntary collection by the public on special days during the year, providing informational brochures on types of special waste, and operation of cooperative waste exchanges.

Special waste screening starts during collection, and is conducted by the vehicle operators. Waste transported and tipped at the MRF will have a second opportunity for waste screening. Special waste found at the MRF will be removed and stored in designated containers. These special waste containers will be provided for household hazardous waste (HHW), medical waste, animal carcasses, and other non-recyclable/non-compostable waste.

A presorting platform has been depicted in the plan view of the MRF. One of the primary purposes of the screening process at this location is the removal of household hazardous and other unacceptable waste prior to being processed. The platform and general arrangement have been designed to facilitate this operation. Approximately four personnel will be required to perform this task at the necessary rate of throughput if an automatic bag breaker is used. If the bags are to be opened manually, provisions for additional workers (2 to 3 additional personnel) are available.

At the MRF, HHW will be stored and delivered to a Subtitle "C" landfill or incinerator. Because there are currently no suitable disposal facilities in Arizona, Chem Waste in Houston, Texas, was contacted with regard to the costs associated with HHW disposal. Disposal costs ranged from $60 to $100 annually for every participating household, although many factors can influence this cost. Community projects and reuse opportunities usually available to communities can play a major role in the HHW disposal cost. Based on the waste characterization data, a low percentage of the waste was classified in this category. It is estimated that approximately 0.3 percent of the waste received at the MRF, will be HHW. Costs of disposal essentially involve those associated with shipping and the tipping fee at the nearest Subtitle "C" facility. Therefore, an annual allotment of $50,000 has been included for the disposal of HHW.

A supervisor must be trained to identify and handle special waste. Unacceptable waste should be stored temporarily onsite in special containers if it does not represent a hazardous condition. This material should be checked regularly and removed as warranted from the facility and placed in the nearest approved landfill. Hazardous materials shall be immediately contained then removed from the building and placed in a certified hazardous waste locker. Final removal from the facility should comply with applicable Federal, state, and local requirements.

The storage of unacceptable non-hazardous material will be in roll-off containers. Unacceptable waste, determined to be non-hazardous by the supervisor, should be temporarily stored on site in these containers. Reject material containers should be covered with tarps to prevent vector and/or scavenger infestation.

The hazardous waste lockers are prefabricated self-contained units housed in a weatherproof building. The building should be designed to provide: secondary containment for liquids; fire protection; personnel safety; and security for handling hazardous wastes received at the facility. The locker and building shall be constructed of chemical resistant coated steel surfaces. The building shall be equipped with liquid spill containment with a sump, a dry chemical fire suppression system with an alarm, proper ventilation, static ground connections, proper anchorage to the foundation, and hazard labeling. It should be approximately 15 feet long by 9 feet wide by 9 feet tall. The entrance to the building shall be provided with 80 inch tall by 54 inch wide doorways. It should be capable of storing up to 25,000 pounds of material in drums, pallets, or other approved containers.

The lockers should be provided with permanent placards and NFPA 704M rating signs for flammable materials, corrosives, oxidizers, poisons, and other hazardous materials as applicable. The lockers shall maintain a Factory Mutual and UL approved status.

The tipping floor supervisor and other personnel inspecting the waste stream at the transfer station and MRF shall be trained in the proper handling of waste, as well as the identification of unacceptable and hazardous waste. This training should include attendance at applicable and warranted seminars, which include the study of required informational data from EPA, OSHA, and other recognized authorities.

Sorting personnel should be trained in the proper identification and handling of hazardous materials. Handling and removal operations should be performed only by those employees knowledgeable in the required procedures.

DESCRIPTION OF PROCESSING OPERATIONS

Municipal solid waste will be accepted and processed at the facility. Municipal waste is defined as residential waste and commercial, agricultural, governmental, industrial, and institutional wastes which have chemical and physical characteristics similar to residential waste. No hazardous, special, or medical wastes will be accepted.

The processing system design has a specific purpose and primary goal to recover one or more materials from the waste stream. The County's main goal is to minimize the amount of material going to the landfill. Based on this requirement, a conceptual system was designed to recover recyclable materials and produce a separate compostable fraction from the waste stream. If other specific goals or requirements are introduced, layout revisions may be warranted. Source separated spoiled produce or other organic fractions should be diverted at the MRF entrance gate to maintain the best possible operation. The receiving of other types of recyclable source separated material should be performed on a planned basis to minimize handling costs at the MRF.

Vehicle Access

The facility will include a processing building as well as roadways for ingress, egress, truck maneuvering, vehicle parking, and landscape improvements. Site improvements will include asphaltic concrete roadways that surround the facility to provide adequate access and traffic flow. Waste route collection trucks and transfer tractor/trailer vehicles will enter the facility site by way of ingress roads as shown on the site drawing. These vehicles will maneuver and back through roll-up doorways located at the entrance to the tipping floor. The trucks and trailers will dump all solid waste inside the building on the primary tipping floor.

Receiving Area

The tipping floor will consist of a sloped concrete floor slab. The floor slab is sloped and routes any liquids into a trench drain located along the entrance of the building. Once the collection trucks and transfer tractor/trailers dump their loads on the tipping floor, they will then exit the facility. The tipping floor will provide an area of approximately 5,000 square feet with an

estimated operating storage capacity of 150 tons (2 days) of waste based upon an average density of 300 pounds per cubic yard. The estimated manpower requirements in this area will include one tipping floor supervisor, one floor laborer, and one equipment operator.

Presorting

Waste screening begins with the collection vehicle drivers. However, in this case, collection is performed by independent haulers or the City. These personnel should be trained to visually examine the waste at the pickup locations and to leave that waste determined to be unacceptable.

Material delivered to the MRF will be dumped on the tipping floor. This material will be visually screened by the tipping floor supervisor. The main infeed conveyor line shall be fed directly by an articulated front-end loader that has a 4 cubic yard clamshell bucket attachment (or similar). The loader has the capacity to feed the conveyor at a rate in excess of 10 tons per hour (TPH). Large bulky and unauthorized material will be placed in roll-off containers located on the tipping floor via mobile equipment (e.g., bobcat or front-end loader).

An infeed hopper with screw augers will be located above the main infeed conveyors and will automatically debag the waste. Material placed in the infeed hopper (i.e., debagger) will fall onto the receiving conveyor and be conveyed up an inclined flight conveyor by a 60-inch wide cleated belt operating at a speed of 10 to 15 feet per minute to the sorting, screening, and material inspection station. Final speed selection is typically fixed and based on the throughput requirements, density, and other specific characteristics of the conveyor. The design throughput of the processing line is estimated at 10 TPH. This should allow for sufficient excess capacity to recover from breaks, downtime, etc.

The main infeed conveyor will transfer the material thorough the screening area. At the screening area, bulky paper products will be manually removed. Reject material will be immediately dropped into a roll-off container located under this station. Typical reject material will consist of unwanted household waste and/or bulky materials, such as long pieces of wood, rubble, wire, large metal containers, as well as unacceptable materials that have inadvertently been received, such as HHW.

The identification of hazardous material in the waste stream will cause an immediate shut down of operations. Hazardous materials will be temporarily stored in a hazardous waste locker located outside the building.

In the event that a delivery vehicle contains large quantities of unacceptable waste, this material will be reloaded into the delivery vehicle and removed from the site. Personnel trained in the handling and disposal of hazardous waste shall remove the material.

The estimated manpower requirements for pre-sorting include four sorting laborers.

Processing Area

Material that passes through the primary inspection station will be transferred onto the recyclables sorting conveyor. This conveyor will be a 60-inch wide slider bed conveyor

operating at 15 to 20 feet per minute. The sorting area should be enclosed with controlled ventilation and air conditioning. The conveyor speed is typically fixed. Sorters on both sides of the conveyor sort recyclables such as corrugated cardboard, newsprint, clear glass, brown glass, and green glass. An extra sorting station is provided for overloads of any material or the addition of a different recyclable. These recyclables will be dropped into chutes leading to containers below the platform. When the storage containers are full, they will be removed and replaced with an empty container.

After the manual sorting station area, the material will be conveyed into a screening trammel. At the screening trammel, material smaller than 1-1/2 inches in diameter will fall through perforations in the shell of the trammel. This smaller material, consisting of organic materials with some non-organics will be diverted by way of a slider bed conveyor to a roll-off container located outside the building for further processing as a compostable fraction.

The remaining material over 1-1/2 inches in diameter exits the trammel onto a third slider bed conveyor that routes the material to a final manual sorting area. This sliderbed conveyor is 48-inches wide and operates at 20 to 30 feet per minute. This manual sorting station is elevated and includes a magnet to separate ferrous materials. Ferrous material removed by the magnet would be deposited into a container below the platform.

Sorters on the platform would separate the remaining resalable plastic materials such as HDPE and PET. The waste stream enters an ELPAC aluminum separator. This mechanized aluminum separator detects aluminum as it rolls down an incline. Timed air pulses then propel the cans into a bin while the remainder of the waste falls through to a reject bin.

Recyclable materials such as paper and plastic will be stored beneath each of the sorting platforms in bunches until enough material has accumulated to constitute baling. The material will then be pushed from the bunkers to the baling conveyor where it will be conveyed up to the baler hopper and baled. Baled materials will be moved to the storage area until a sufficient amount is accumulated to ship to a processor.

PERSONNEL TRAINING

All personnel coming into contact with the waste stream should be trained in the proper techniques of handling both acceptable and unacceptable wastes. This training typically includes attendance at applicable and warranted seminars that include the required informational data from EPA, OSHA, and other recognized authorities.

Other sorting personnel will require training in the proper handling of unacceptable waste and the identification of hazardous materials. Information on hazardous materials should be provided to these employees on a regular basis. Handling and removal operations should be performed only by those employees knowledgeable in the required procedures. All employees should also be trained on operating policies and procedures for their job related tasks. Equipment operators are usually trained individually on the proper procedures and methods of operating their respective equipment. Manual sorting personnel will require instruction both on the job and in a classroom style setting on proper methods of sorting, specific job requirements, potential hazards, and methods and procedures for appropriate conduct during emergency events. The

level of detail for instructional training will vary depending on the job function and safety record of the facility relative to the applicable job task. Employee training normally includes, but is not limited to the following:

- Group instruction by outside contractors and equipment suppliers on equipment and/or specialized methods and procedures of operations for specific events.
- Instruction by supervisors on methods, procedures, and required records for housekeeping functions.
- Emergency response procedures for containment, cleanup, and reporting hazardous materials and wastes.
- Emergency response methods, procedures, and reporting of fires, severe weather, employee injury, and first aid.
- Instruction for identifying, reporting, and handling unacceptable and/or hazardous waste.
- Use and location of safety controls and devices, and requirements involving personnel equipment such as safety shoes, proper dress, gloves, hard hats, safety glasses, aprons, etc.

It is estimated that one to two 8-hour training periods will be necessary to provide the required level of training to the facility labor force. Additional refresher courses will also be warranted on an annual or more frequent basis.

Processing equipment will require trained operators and maintenance personnel. Training for these personnel will be accomplished by manufacturer representatives and technicians. This training will consist of classroom training on the average of three to four 8 hour days, depending on the complexity of the equipment being discussed. Specialized programs will be required specifically addressing the equipment and its operation.

CONCEPTUAL FACILITY PROCESS SYSTEM LAYOUTS

DRAWING LIST

WASTE COMPOSITION SUMMARY TABLES

TABLE 4-1 MANUALLY SORTED AND WEIGHED DATA
TABLE 4-2 VISUALLY SCREENED DATA
TABLE 4-3 WEIGHTED COMPOSITE SUMMARY OF DATA

TABLE 4-1

WASTE COMPOSITION SUMMARY

SCS ENGINEERS — COUNTY OF SANTA CRUZ, ARIZONA

PROJECTED COMPOSITION FOR 50 TONS PER DAY BASED ON MANUAL SORTATION WASTE CHARACTERIZATION			RECOVERY RATE OF PRODUCTS						NON-RECOVERABLE	
			COMPOSTABLE		R. D. FUEL		RESALEABLE		LANDFILL REJECT	
MATERIAL DESCRIPTION	% by Wt.	T.P.D.	%	LBS	%	LBS	%	LBS	%	LBS
PAPER/PULP PRODUCTS	**39.4%**	**19.70**								
Newspaper	3.8%	1.90	10.0%	380	0.0%	0	60.0%	2,280	30.0%	1,140
Cardboard	19.5%	9.75	10.0%	1,950	0.0%	0	60.0%	11,700	30.0%	5,850
Magazines/Glossy	1.0%	0.50	10.0%	100	0.0%	0	0.0%	0	90.0%	900
Office/Computer Paper	1.4%	0.70	10.0%	140	0.0%	0	0.0%	0	90.0%	1,260
Other Mixed Paper	13.7%	6.85	10.0%	1,370	0.0%	0	0.0%	0	90.0%	12,330
PLASTIC PRODUCTS	**11.6%**	**5.80**								
PET Bottles	0.6%	0.30	0.0%	0	0.0%	0	99.0%	594	1.0%	6
HDPE Bottles	1.1%	0.55	0.0%	0	0.0%	0	99.0%	1,089	1.0%	11
Films/Bags	6.1%	3.05	0.0%	0	0.0%	0	0.0%	0	100.0%	6,100
Other Plastics	3.8%	1.90	5.0%	190	0.0%	0	0.0%	0	95.0%	3,610
YARD WASTE	**7.5%**	**3.75**								
Misc. Yard Waste	7.5%	3.75	60.0%	4,500	0.0%	0	0.0%	0	40.0%	3,000
						0				
MISC. ORGANICS	**30.0%**	**15.00**								
Wood/Lumber	3.4%	1.70	75.0%	2,550	0.0%	0	0.0%	0	25.0%	850
Textiles/Rubber/Leather	2.4%	1.20	75.0%	1,800	0.0%	0	0.0%	0	25.0%	600
Food Wastes	8.4%	4.20	70.0%	5,880	0.0%	0	0.0%	0	30.0%	2,520
Other Organics	15.8%	7.90	75.0%	11,850	0.0%	0	0.0%	0	25.0%	3,950
GLASS	**3.4%**	**1.70**								
Clear Glass Containers	2.4%	1.20	25.0%	600	0.0%	0	75.0%	1,800	0.0%	0
Green Glass Containers	0.1%	0.05	25.0%	25	0.0%	0	75.0%	75	0.0%	0
Brown Glass Containers	0.8%	0.40	25.0%	200	0.0%	0	75.0%	600	0.0%	0
Other Glass Containers	0.1%	0.05	25.0%	25	0.0%	0	75.0%	75	0.0%	0
METALS	**5.4%**	**2.70**								
Ferrous Containers (tinned)	1.6%	0.80	5.0%	80	0.0%	0	95.0%	1,520	0.0%	0
Other Ferrous Metal	2.8%	1.40	5.0%	140	0.0%	0	95.0%	2,660	0.0%	0
Non-ferrous Metal (total)	1.0%	0.50								
Beverage Cans	0.7%	0.35	5.0%	35	0.0%	0	92.5%	648	2.5%	18
Other Non-Ferr. Metals	0.3%	0.15	5.0%	15	0.0%	0	92.5%	278	2.5%	8
MISC. INORG. MATL.	**1.3%**	**0.65**								
Misc. Inorganics	1.3%	0.65	50.0%	650	0.0%	0	0.0%	0	50.0%	650
OTHER WASTE	**1.4%**	**0.70**								
Other Waste	1.4%	0.70	50.0%	700	0.0%	0	0.0%	0	50.0%	700
TOTAL	100.0%	50.00 TONS		33,180		0		23,318		43,502

SUMMARY:					
COMPOST %	29.7%		COMPOSTABLE FRACTION OF WASTE	MATERIAL "REJECTS" TO A LANDFILL W/O COMPOSTING	
R. D. FUEL %	0.0%		16.6 TONS PER DAY	Direct Transfer of Ash (15% weight reduction)	N/A tpd
RESALEABLE %	23.3%		COMPOST REJECT FRACTION	Direct Transfer of Compostable Material	16.6 tpd
LANDFILL REDUCTION % (*)		53%	1.8 TONS PER DAY	Direct Transfer of Reject Material	21.8 tpd
LANDFILL REJECT % (*)		47% →	(*) Rejects w/ Composting	Total Material Transferred 76.7%	38.3 tpd

TABLE 4-2

WASTE COMPOSITION SUMMARY

SCS ENGINEERS — COUNTY OF SANTA CRUZ, ARIZONA — D:\1092010\task1\T4-2.wk1

PROJECTED COMPOSITION FOR 25 TONS PER DAY BASED ON VISUAL WASTE CHARACTERIZATION			RECOVERY RATE OF PRODUCTS						NON-RECOVERABLE	
			COMPOSTABLE		R. D. FUEL		RESALEABLE		LANDFILL REJECT	
MATERIAL DESCRIPTION	% by Wt.	T.P.D.	%	LBS	%	LBS	%	LBS	%	LBS
PAPER/PULP PRODUCTS	**8.7%**	**2.18**								
Cardboard	7.7%	1.93	10.0%	386	0.0%	0	90.0%	3,474	0.0%	0
Other Mixed Paper	1.0%	0.25	10.0%	50	0.0%	0	0.0%	0	90.0%	450
PLASTIC PRODUCTS	**0.4%**	**0.10**								
Other Plastics	0.4%	0.10	5.0%	10	0.0%	0	0.0%	0	100.0%	200
YARD WASTE	**18.3%**	**4.58**								
Misc. Yard Waste	18.3%	4.58	60.0%	5,496	0.0%	0	0.0%	0	40.0%	3,664
						0				
MISC. ORGANICS	**29.7%**	**7.44**								
Wood/Lumber	7.1%	1.78	75.0%	2,670	0.0%	0	0.0%	0	25.0%	890
Textiles/Rubber/Leather	1.3%	0.33	75.0%	495	0.0%	0	0.0%	0	25.0%	165
Food Wastes	21.3%	5.33	70.0%	7,462	0.0%	0	0.0%	0	30.0%	3,198
GLASS	**0.0%**	**0.00**								
Clear Glass Containers	0.0%	0.00	25.0%	0	0.0%	0	75.0%	0	0.0%	0
Green Glass Containers	0.0%	0.00	25.0%	0	0.0%	0	75.0%	0	0.0%	0
Brown Glass Containers	0.0%	0.00	25.0%	0	0.0%	0	75.0%	0	0.0%	0
Other Glass Containers	0.0%	0.00	25.0%	0	0.0%	0	75.0%	0	0.0%	0
METALS	**9.4%**	**2.36**								
Other Ferrous Metal	7.5%	1.88	5.0%	188	0.0%	0	95.0%	3,572	0.0%	0
Non-ferrous Metal (total)	1.9%	0.48								
MISC. INORG. MATL.	**17.1%**	**4.28**								
Dry Wall	10.4%	2.60	15.0%	780	0.0%	0	0.0%	0	85.0%	4,420
Masonry	1.0%	0.25	15.0%	75	0.0%	0	0.0%	0	85.0%	425
Roofing Materials	5.7%	1.43	15.0%	429	0.0%	0	0.0%	0	85.0%	2,431
OTHER WASTE	**16.4%**	**4.10**								
Other waste (bagged waste)	16.4%	4.10	50.0%	4,100	0.0%	0	0.0%	0	50.0%	4,100
TOTAL	100.0%	25.04 TONS		22,141		0		7,046		19,943

SUMMARY:					
COMPOST %	35.5%		COMPOSTABLE FRACTION OF WASTE	MATERIAL "REJECTS" TO A LANDFILL W/O COMPOSTING	
R. D. FUEL %	0.0%		11.1 TONS PER DAY	Direct Transfer of Ash (15% weight reduction)	0.0 tpd
RESALEABLE %	14.1%		COMPOST REJECT FRACTION	Direct Transfer of Compostable Material	11.1 tpd
LANDFILL REDUCTION % (*)	**49.6%**		2.2 TONS PER DAY	Direct Transfer of Reject Material	10.0 tpd
LANDFILL REJECT % (*)	**50.4%** →		(*) Rejects w/ Composting	Total Material Transferred **84.4%**	21.1 tpd

TABLE 4-3

WASTE COMPOSITION SUMMARY

SCS ENGINEERS — COUNTY OF SANTA CRUZ, ARIZONA

WEIGHTED SUMMARY OF TABLE 4-1 AND TABLE 4-2

MATERIAL DESCRIPTION	% by Wt.	T.P.D.	RECOVERY RATE OF PRODUCTS: COMPOSTABLE %	COMPOSTABLE LBS	R. D. FUEL %	R. D. FUEL LBS	RESALEABLE %	RESALEABLE LBS	NON-RECOVERABLE LANDFILL REJECT %	NON-RECOVERABLE LANDFILL REJECT LBS
PAPER/PULP PRODUCTS	**29.2%**	**21.88**								
Newspaper	2.5%	1.90	10.0%	380	0.0%	0	60.0%	2,280	30.0%	1,140
Cardboard	15.6%	11.68	10.0%	2,335	0.0%	0	60.0%	14,010	30.0%	7,005
Magazines/Glossy	0.7%	0.50	10.0%	100	0.0%	0	0.0%	0	90.0%	900
Office/Computer Paper	0.9%	0.70	10.0%	140	0.0%	0	0.0%	0	90.0%	1,260
Other Mixed Paper	9.5%	7.10	10.0%	1,420	0.0%	0	0.0%	0	90.0%	12,780
PLASTIC PRODUCTS	**7.9%**	**5.93**								
PET Bottles	0.4%	0.30	0.0%	0	0.0%	0	99.0%	594	1.0%	6
HDPE Bottles	0.7%	0.53	0.0%	0	0.0%	0	99.0%	1,040	1.0%	11
Films/Bags	4.1%	3.08	0.0%	0	0.0%	0	0.0%	0	100.0%	6,150
Other Plastics	2.7%	2.03	5.0%	203	0.0%	0	0.0%	0	95.0%	3,848
YARD WASTE	**11.1%**	**8.33**								
Misc. Yard Waste	11.1%	8.33	60.0%	9,990	0.0%	0	0.0%	0	40.0%	6,660
MISC. ORGANICS	**29.80%**	**22.35**								
Wood/Lumber	4.6%	3.45	75.0%	5,175	0.0%	0	0.0%	0	25.0%	1,725
Textiles/Rubber/Leather	2.0%	1.50	75.0%	2,250	0.0%	0	0.0%	0	25.0%	750
Food Wastes	12.7%	9.53	70.0%	13,335	0.0%	0	0.0%	0	30.0%	5,715
Other Organics	10.5%	7.88	75.0%	11,813	0.0%	0	0.0%	0	25.0%	3,938
GLASS	**2.3%**	**1.70**								
Clear Glass Containers	1.6%	1.20	25.0%	600	0.0%	0	75.0%	1,800	0.0%	0
Green Glass Containers	0.1%	0.05	25.0%	25	0.0%	0	75.0%	75	0.0%	0
Brown Glass Containers	0.5%	0.40	25.0%	200	0.0%	0	75.0%	600	0.0%	0
Other Glass Containers	0.1%	0.05	25.0%	25	0.0%	0	75.0%	75	0.0%	0
METALS	**6.7%**	**5.03**								
Ferrous Containers (tinned)	1.1%	0.83	5.0%	83	0.0%	0	95.0%	1,568	0.0%	0
Other Ferrous Metal	4.4%	3.30	5.0%	330	0.0%	0	95.0%	6,270	0.0%	0
Non-ferrous Metal (total)	1.2%	0.90								
Beverage Cans	0.5%	0.35	5.0%	35	0.0%	0	92.5%	648	2.5%	18
Other Non-Ferr. Metals	0.7%	0.53	5.0%	53	0.0%	0	5.0%	53	90.0%	945
MISC. INORG. MATL.	**6.6%**	**4.93**								
Misc. Inorganics	0.9%	0.65	50.0%	650	0.0%	0	0.0%	0	50.0%	650
Dry Wall	3.5%	2.60	15.0%	780	0.0%	0	0.0%	0	85.0%	4,420
Masonry	0.3%	0.25	15.0%	75	0.0%	0	0.0%	0	85.0%	425
Roofing Material	1.9%	1.43	15.0%	428	0.0%	0	0.0%	0	85.0%	2,423
OTHER WASTE	**6.4%**	**4.80**								
Other Waste	6.4%	4.80	50.0%	4,800	0.0%	0	0.0%	0	50.0%	4,800
TOTAL	100.0%	74.93 TONS		55,223		0		29,011		65,567

SUMMARY:

COMPOSTABLE %	31.6%	
R. D. FUEL %	0.0%	
RESALEABLE %	19.3%	
MAX. LANDFILL REDUCTION %	**50.9%** (*)	
LANDFILL REJECT % (*)	**49.1%** →	

COMPOSTABLE FRACTION OF WASTE
27.6 TONS PER DAY

COMPOST REJECT FRACTION
3.9 TONS PER DAY

(*) w/ Composting

MATERIAL "REJECTS" TO A LANDFILL W/O COMPOSTING

Direct Transfer of Ash (15% weight reduction)		n/a
Direct Transfer of Compostable Material		27.6 tpd
Direct Transfer of Reject Material		32.8 tpd
Total Material Transferred	**80.7%**	60.4 tpd

SECTION 5

ECONOMIC EVALUATIONS

INTRODUCTION

Economic evaluations were made to determine the value of potentially recyclable material in the County waste stream. In addition, recycling markets were researched and the estimated costs of design, permitting, construction, and operation of a MRF were developed. Using this information, the projected costs and feasibility of a MRF can be determined.

The first portion of this analyses pertains to the value of potential recyclable material and market conditions in the area. The second portion analyzes the costs associated with the design, permitting, construction, and operation of a MRF.

ASSESSMENT OF RECYCLABLE MATERIAL VALUE

A primary task that must be performed to determine the feasibility of MRFs is an assessment of the value of the products that are produced. The assessment of the recyclable markets and the respective value of products produced from a processing facility include:

- Determining the value of paper products that could be recovered from the conceptually designed processing facility.
- Identifying potential uses and/or value of materials recovered from the waste stream that could be used by the County.
- Determining the current wholesale market value of materials that would be recovered at a processing facility (e.g., glass, aluminum, steel, plastics).
- Determining of the value of any compost end product.

The calculated value of recovered products should be based on a dollars per ton received basis. This allows for the comparative analysis and impact of the processes required to recover and utilize products generated by a MRF. Recoverable product markets are typically not stable and, therefore, the values of any recovered products vary significantly. However, another primary motivating factor for material recovery may be the avoided cost of landfilling.

Several factors are responsible for the interest in the development of a refuse derived fuel (RDF) alternative. The primary factors in this study include: 1) reduction in the amount of waste entering the landfill; and 2) the use of waste material as a fuel to reduce utility costs. However, there are currently no known markets for this material in the southwestern United States.

Utilization of Recyclable Products

One element examined included a review of recycling opportunities based on regional conditions. True recycling requires that the recovered materials actually be used to produce a new product.

To determine and identify potential uses for products produced by the MRF, the characteristics of the waste constituents and the associated volumes available were determined. This information was developed in Section 1. From this waste characterization information, each category of recovered material and related potential manufacturing operations were analyzed.

Recovered Material Category

Paper Products--

The waste stream consists of approximately 30 to 40 percent paper products. In most manual picking operations, recovery of 50 to 60 percent of the paper products is reasonable. Negatively sorting the material can provide even greater recovery. Usually a cost effective use of this material would be the generation of energy in the form of steam or electricity. This material possesses a high heat value and, when shredded, provides a suitable fuel for burning in incinerators for heat recovery. Several factors are responsible for the interest in the development of a refuse derived fuel (RDF) alternative. The primary factors in this study include: 1) reduction in the amount of waste entering the landfill; and 2) the use of waste material as a fuel to reduce utility costs. However, there are currently no known markets for this material in the southwestern United States.

If the County could identify an existing manufacturing operation or facility that could burn this type of product for beneficial use to offset natural gas costs, utilization of this material in these existing operations could be effective. Paper products recovered in mixed waste processing MRFs are often not of an acceptable quality to many wholesale buyers. Thus, the potential of using this material as a fuel warrants more investigation.

Plastics--

Plastic products have a variety of uses. Currently, recycled plastic is being manufactured into park benches, wharf and dock protection barriers, furniture, landscape ties, and a variety of other products. Based on the waste characterization data, approximately 0.4 percent of the composite waste stream (by weight) was classified as PET (Polyethylene Terephthalate), while 0.7 percent was HDPE (High Density Polyethylene). Another 6.8 percent represents other plastics.

Typically, only HDPE and PET plastics can be readily recycled. From 90 to 99 percent of these types of plastic are recoverable from the waste stream. Finding a plastics manufacturer that utilizes recovered plastic products to locate in the Nogales area could be a possibility if established quality and quantities of materials can be produced. Unfortunately, the relatively small volume of plastics that would be generated by a MRF at the Santa Cruz County landfill would not on its own, support a facility of this nature. Therefore, any such facility would also need virgin supplies of materials.

Yard Waste--

Yard waste comprises approximately 11 percent of the waste stream. Currently, the composting of yard waste is a readily acceptable means of management to preclude its disposal in the landfill. Use of yard waste in combination with sewage sludge has provided high quality compost in several areas of the country. This could represent a cooperative effort between the local wastewater treatment facilities and the County.

Organic Waste--

Approximately 30 percent of the waste stream consists of organic waste. This material includes wood, food waste, and other organics. When combined with yard waste, this material is often referred to as the compostable fraction of municipal solid waste. Based on the labor and availability of land, composting could represent a significant program for the County. The cost of composting is offset by tipping fees paid by facility users and the avoided landfill costs.

In addition, significant quantities of spoiled produce is currently brought to the landfill during the months of November through May. This material is usually source separated and thus can be utilized as a compost feedstock. Source separated food waste has been proven a good source of high quality compost. This material can be composted alone or mixed with the reject from a MRF on a pilot basis until assurances of quality and contaminant levels are determined.

Glass--

The total fraction of glass (all colors) in the waste stream represents approximately 2.3 percent of the total waste stream. Users of glass require it to be sorted by color. Its value ranges from $5.00 to $7.50 per ton.

Glass fragments have been utilized in road pavements (known as Glasphalt). This requires the grinding of glass and the mixing of the ground glass into asphalt mixes. Utilization of mixed glass in this manner could be performed by the County with the final products sold to the state highway department. Recovery on the order of 40 to 60 percent of the glass in the mixed waste stream is typically achievable by conventional MRFs.

Experimental use of glass for drainage material and other activities has also been performed. In fact, recent revisions to the Uniform Plumbing Code include the use of crushed glass as pipe bedding. In addition to selling the glass, the County could incorporate these potential uses into daily County operations.

The recovery of glass in MRFs has been targeted as a primary cause of cuts and related injuries. Glass recovery by sorting is not recommended unless no other source of revenue is available. The conceptual design drawings indicate locations for glass sorters, these sorting locations could be removed without impact to the processing operation and a screen installed prior to the trammel for glass recovery.

Metals--

Approximately 6.7 percent of the composite waste stream consists of ferrous and non-ferrous metals. Non-ferrous beverage cans (aluminum) comprise approximately 0.5 percent of the waste stream. The current value of this material is around $0.20 to $0.30 per pound. Processes associated with the use of aluminum are cost and volume intensive. Therefore, the best use of this material would be to sell the material to aluminum re-processors directly.

As in the aluminum recycling arena, ferrous metals are typically sold to scrap dealers at wholesale value.

Inorganics--

Approximately 6.6 percent (by weight) of the composite waste stream consists of inorganic materials. This material represents one of the primary constituents of the material rejected and sent to a landfill from the MRF.

Other Waste--

Approximately 6.4 percent of the composite waste stream was classified as "other waste". This material typically cannot be used by any known manufacturing operations. This consists of tires, household hazardous waste (HHW), etc. This material if removed from the waste stream cannot be sent to a landfill in Arizona. Currently, the county collects tires and white goods at the landfill and this practice would be expected to be performed at a MRF.

Recoverable Material Wholesale Value

The value of recoverable material removed from the waste stream must be assessed to properly determine the feasibility of a processing facility. To make this determination, the type of material, quantity, and quality must be evaluated. Tables 4-1, 4-2, and 4-3 in Section 4 represent the mix of materials that a processing facility would receive. The performance and recovery rates of materials are directly related to the design of the facility. The anticipated recovery rates are also indicated. By applying the market value that wholesale buyers are currently willing to pay to the weights of specific recyclable materials recovered, the potential revenues can be obtained from the respective recoverable constituents of the waste stream.

Historically, buyers of recyclable materials have been vary cautious with regard to materials recovered from mixed waste material recovery systems. In many cases these materials are considered contaminated. To overcome this perception and in some cases fact, source separation and selected route pickup arrangements may be warranted.

Private sector markets were contacted to determine the current value of certain specific recyclable materials. The data collected is summarized in Table 5-1 based on the technology of the processing facility. These prices are not firm, but represent the average price quoted from buyers of the material at the time they were contacted.

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Sources of Pricing

Waste Age's Recycling Times - August 1992 Commodity Price Index--

These prices do not reflect exact prices paid, but are regional averages tabulated to show general price values and changes.

Paper--

Newsprint value is $0 to $5 per ton (baled).
Corrugated cardboard value is $10 per ton (baled).
Computer printout value is $95 to $150 per ton (baled).
White ledger value is $35 to $60 per ton (baled).
Colored ledger value is $20 to $25 per ton (baled).

Glass--

Clear glass value is $0 to $10 per ton.
Other glass Colors have no value.

Aluminum--

Beverage can value is $0.23 to $0.30 per pound.

Steel--

Tin can value is $80 to $87 per baled gross ton (2,240 lbs.).

The Waste Management Company in Tucson, Arizona--

Currently, The Santa Cruz County Landfill delivers recyclables from a public drop-off area to The Waste Management Company in Tucson. The prices provided by The Waste Management Company are based on the assumption that materials will be delivered to their facility. Currently, aluminum in can form, is valued at 30 cents per pound. Newsprint is valued at 1 cent per pound. Tin cans, plastic, and glass is accepted, but has no value. Waste Management also accepts car batteries at $2 per battery and waste oil (no value).

Proler Recycling, Houston, Texas--

The prices provided by Proler Recycling are based on the assumption that materials will be delivered to their facility. Currently, steel cans are accepted in any form (e.g., loose, shredded, or baled) and are valued at $60 per gross ton. Prices for the following ferrous metals were quoted: turning - $20 per ton; scrap rail - $85 per ton; pipe - $65 per ton; and plate - $65 per ton. Non-ferrous metal prices varied as well; currently, copper #1 is valued at $1.00 per pound. Proler does not accept aluminum.

Vista Fiber, Houston, Texas--

The prices provided by Vista Fiber are based on the assumption that materials will be delivered to their facility. Clear PET plastic is currently valued at 2.5 cents per pound and colored PET plastic is valued at 0.5 cents per pound. HDPE natural colored plastic is valued at 4 cents per pound and colored HDPE is valued at 1 cent per pound. Vista requires that all paper be removed from the plastic.

Vista accepts clear glass and pays $20 per ton. Although Vista will accept steel cans, they are not paying for steel at this time.

General Market Conditions

The 1992 market picture indicates a consistent oversupply of the primary recyclable products typically recovered from a MRF.

Value used with regard to the recovery of paper products at the MRF can vary and is based on wholesaler purchase for reuse. This may not be possible depending on the quality of the paper. This material is more valuable if burned in an energy recovery boiler than if recovered for resale. In addition, wholesale buyers typically regard paper products recovered from mixed municipal waste processing facilities as unsuitable.

The value of glass was based on local market conditions. Also, glass recovered from mixed municipal waste facilities is often determined unsuitable. Based on this information, the cost of recovery, and the available uses, it is recommended that the County stockpile and reuse this material. Such uses would include, Glasphalt, road bedding, and drainage base material.

No value was assigned to the compostable fraction material. Due to market conditions, it is believed that this material will not have a retail value. It is believed that this material, however, can be utilized by the County. Therefore, it is believed that there would be no additional cost associated with the disposal of this material other than at a landfill and, thus, there is an avoided cost associated with the processing and land application of this material.

MATERIAL RECOVERY FACILITY COSTS

The following examines the costs related to the design, permitting, construction, and operation of the conceptually designed MRF. The conceptual design is based on one 8 hour operating shift per day.

Material Recovery Facility Capital Costs

The capital costs associated with the MRF are considered in this section. Getting an accurate picture of real MRF costs is difficult. Therefore, a conceptual design of a MRF specifically designed and based on the data collected for the Santa Cruz County area was developed.

Existing facilities that have shared cost information have exhibited no clear cost patterns. Capital costs for six MRF projects started in 1990 that had capacities of 100 to 200 TPD ranged from

$1,000,000 to $6,000,000. This range of costs is primarily related to the different technologies applied in each case. Therefore, a conceptual layout for a processing system was developed that allows a more accurate view of the specific costs associated with the facility.

The conceptual design was then used to develop capital costs. Primary features and the costs associated with these features were defined. The associated facility and building costs and equipment costs were developed separately. Costs associated with equipment are specifically based on a conceptual design customized to the waste stream generated by the County.

Table 5-1 defines processing equipment capital costs as approximately $1,147,000. Included in the rolling stock is a live floor transfer trailer, tractor and roll-off jockey for the transfer of reject material to the landfill. These costs may be avoided if other means of transfer by the County can be arranged, or if the County is currently in possession of this equipment.

Table 5-2 illustrates the building construction costs. Building construction capital costs are estimated to be $977,000 and are derived from the conceptual design. Costs were prepared using the Means Construction Cost Data, 1991 Edition and other related cost factors based on experience, manufactures data, and other similar projects.

Items that are not fully explained in Table 5-2 include the following:

- Special exhaust ventilation: This is an allowance for point source ventilation of heavy dust producers such as the baler and the air supply to manual sorters on the sorting platforms.

- Utilities: Allowances for distribution lines were given by estimating the length of piping for water and sewer. This cost could experience a minor fluctuation depending on the actual lengths of pipe required.

Material Recovery Facility Operating Costs

The operating costs associated with the MRF were developed in this section. As with the capital costs, an accurate picture of real MRF operating costs is difficult to define. Operating costs for several projects were surveyed by Biocycle Magazine. The results of this survey indicated that for MRFs with capacities of 100 to 200 TPD, costs ranged from $12.80 to $59.20 per ton of material received and processed. In each case, the range of operating costs related to the technology applied. The cost of labor is typically the single most important factor in these facilities. To obtain a more accurate view of operational costs, a conceptual processing system layout was developed.

The MRF operating costs, Table 5-3, includes four primary cost categories and one revenue category. Operational costs include utilities, labor, parts and supplies for administration, production and maintenance requirements, and waste disposal costs. Operational revenues consist of the values placed on recovered materials. As indicated in the operational costs, labor makes up the primary portion of the overall operating costs.

Revenue is derived primarily from the purchase of recyclables by Waste Management in Tucson. This information is illustrated on Table 5-4. Recyclables are presently hauled to Tucson by the Santa Cruz County Landfill.

Summary of Costs

Based on the results of the capital and operating costs a tipping fee was developed for the facility arrangement conceptually designed. This tipping fee accounts for revenues generated from the sale of the recoverable materials. The net impact of all these costs are defined on Table 5-5 Cost Analysis Summary. The projected initial tipping fee for the conceptually designed MRF would be $49 per ton. This tipping fee would pay for all capital costs, operating costs, etc. for the facility. For a worse case analysis, the amount of revenue could be reduced to a lower amount.

A cost comparison was made of the MRF under construction in Huachuca City. Mr. Terry McGriff from the City of Huachuca was contacted to obtain this information. Mr. McGriff reported that the facility capital costs were going to be approximately $2,000,000. This cost includes the building and the process system. A packaged process system manufacturer was selected to provide the equipment. The facility consists of three primary infeed systems. One line receives and processes wood and yard waste. This line feeds this material directly to a large grinder. This material (e.g. wood and yard waste) once it has passed through the grinder is then sent to be composted. Another line receives city and county residential and commercial garbage. This system feeds a manual sorting line. Material remaining on the conveyor after sorting is directed into the large grinder previously referenced. Finally, a third line is provided for handling source separated materials and materials separated from the MSW. This line receives the material and routes it into a baler. Material separated at the MRF is also routed to this line so that the sorted material can be densified for shipping. The tip fee for the facility has been estimated by the City to be approximately $35 per ton based on a throughput of 100 TPD.

As can be seen from this comparison, the capital costs of the MRF conceptually designed for Santa Cruz County is essential the same (e.g. $2 Million - Huachuca City vs. $2,124,000 for Santa Cruz County). A difference does exist with regard to the calculated cost per ton (e.g. $35 - Huachuca City vs. $49 for Santa Cruz County). Cost per ton can be deceiving especially when significant volume of source separated material is expected. In view of this difference, the cost difference on a per ton basis appear to be comparable. With regard to throughput, the Huachuca City facility is anticipating handling as much as 150 TPD. Again, this includes source separated and yard waste. Which therefore reduces the ability to make a direct comparison. However, the conceptual design of the Santa Cruz facility is designed for a municipal waste throughput of 75 TPD. In addition, the Santa Cruz facility could also process an additional 15-25 TPD of source separated material which would reduce the cost per ton significantly. Methods of reducing the cost per ton for processing essentially fall within the bounds of labor. As indicated on the estimated operating costs, labor accounts for approximately 45 percent of the operating costs. Sorted specific recyclables and utilization of negative sorting techniques can have dramatic effects of operating costs. These types of strategies are usually developed in the design phase of implementation.

TABLE 5-1

SCS ENGINEERS D:\1092010\TASK5\EQP-A-1A.WK1

TABLE 5-1 MATERIAL RECOVERY FACILITY CONCEPTUAL EQUIPMENT COST ESTIMATE

PROJECT	SANTA CRUZ FEASIBILITY STUDY		
LOCATION		DATE:	10/19/92
QUANTITIES BY	EJF	CHECKED BY	CEM
PRICING BY	EJF	SHEET	1 OF 1

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL COST
	CONVEYORS				
1	Municipal waste receiving conveyor	ft	70	$950	$66,500
	chainbelt with 6" cleats				
2	Sorting conveyor	ft	50	$630	$31,500
	sliderbed conveyor				
3	Sorting conveyor w/10' of stainless	ft	40	$630	$30,200
	sliderbed conveyor				
4	Reject conveyor	ft	45	$500	$27,500
	sliderbed				
5	Unders conveyor beneath trommel	ft	40	$500	$20,000
6	Baling conveyor + pit ($5,000)	ft	25	$800	$25,000
	chainbelt with 6" cleats				
	Subtotal conveyors				$200,700
	OTHER EQUIPMENT				
7	Cross Belt Magnets	each	1	$22,000	$22,000
8	Trommel	each	1	$110,000	$110,000
9	ELPAC Aluminum Separator	each	1	$90,000	$90,000
10	Baler	each	1	$120,000	$120,000
11	Platforms				
	Initial screening $37.5/sq.ft.	sq.ft.	1	1225	$45,938
	main sorting $37.50/sq.ft.	sq.ft.	1	504	$18,900
12	Infeed Hopper w/screw auger	each	1	$60,000	$60,000
13	Containers	lump sum	1	$10,000	$10,000
14	Scales, concrete, etc.	lump sum	1	$50,000	$50,000
	ROLLING STOCK				
14	Fork Truck	each	1	$17,600	$17,600
15	Bobcat	each	1	$16,000	$16,000
16	Articulated Front Loader	each	1	$29,000	$29,000
17	Live Floor Transfer Trailer (OPTIONAL)	each	1	$48,000	$48,000
18	Diesel Tractor Jockey (OPTIONAL)	each	1	$50,000	$50,000
19	Rolloff Jockey (OPTIONAL)	each	1	$80,000	$80,000
	Subtotal other equipment & rolling stock				**$767,438**
	Shipping ($1500 per truckload assuming 80 feet of conveyor per truck)				$10,500
	Equipment Installation				$18,500
	Electrical Installation				$25,000
Equipment Subtotal					**$1,022,138**
CONSTRUCTION SOFT COSTS					
20	Engineering and Contract Estimate			10.0%	$102,214
21	Technical Contingencies			2.0%	$22,487
	TOTAL COST FOR EQUIPMENT				**$1,146,838**

TABLE 5–2

SCS ENGINEERS

MATERIAL RECOVERY FACILITY "BUILDING COSTS" CONCEPTUAL ESTIMATE

PROJECT: SANTA CRUZ FEASIBILITY STUDY

LOCATION — DATE: 10/19/92

QUANTITIES BY: EJF — CHECKED BY: CEM — D:\1092010\TASK5\BLD-A-1A.WK1

PRICING BY: EJF — SHEET 1 OF 1

New building parameter: 19,600 square feet (processing, tipping, storage) 6,160 Square feet of Canopy

BUILDING COSTS

ITEM	DESCRIPTION		SPECIFICATIONS	UNIT COST	TOTAL COST	UNIT
1	Footings and Foundations		Poured concrete and spread footings	2.0	$39,690	S.F. GRND.
2	Site Prep. and excavation		Slab, footings and general site prep.	0.8	$14,700	S.F. GRND.
3	Substructure		Slab 5" reinforced w/ granular base	4.5	$88,200	S.F. AREA
4	Pre–Engineered Bldg. (Shell Only)		Rigid Frame & install	8.0	$156,800	S.F. ROOF
5	Canopy Bldg.		Roof and columns only	2.5	$15,400	S.F. ROOF
6	Windows, doors, etc.		Hollow metal passage, steel overhead doors	1 lot	$28,000	one lot
7	Mechanical	1	Plumbing,	1.0	$29,600	S.F. ROOF
		2	Ventilation and heating	4.5	$88,200	S.F. ROOF
		3	Special exhaust ventilation	1 lot	$40,000	one lot
8	Electrical	1	Service and Distribution	0.5	$29,800	S.F. ROOF
		2	Lighting and Power	2.5	$49,000	S.F. ROOF
		3	Special systems	–	$15,000	one lot
9	Fire Protection	1	Ordinary hazard	1.35	$26,460	S.F. ROOF
10	Utilities	1	Water (200 l.f. of distribution line)	20	$4,000	L.F.
		2	Sewer (200 l.f. of connection line)	14	$2,800	L.F.
11	Site work	1	General Site Drainage (Stormwater)	$15,000	$15,000	One lot
		2	Roads and Parking 150,000 S.F. (gravel and asphalt)	0.7	$105,000	S.F. area
		3	Miscellaneous signage	$1,500	$1,500	One Lot
		4	Chain link fence & entrance Gate (1500 ft, 2 gates–20ft)	16.0	$24,000	One Lot
12	Employee Building	1	Structure and finishes (1500 S.F. floor area)	40$/S.F.	$60,000	One Lot
Constr. Subtotal	>>>				**$833,150**	
CONSTRUCTION SOFT COSTS						
13	Engineering/Permitting & Contract Administration			15%	$124,973	
14	Technical contingencies			2%	$19,162	
	TOTAL COST OF FACILITY CONSTRUCTION				**$977,285**	

TABLE 5-3

OPERATING COSTS FOR A MATERIAL RECOVERY FACILITY

PROJECTED CAPACITY			75 TONS PER DAY	75 TONS RECEIVED AND PROCESSED PER DAY	
DAILY PRODUCTION OPERATIONAL REQUIREMENTS				D:\1092010\TASK 5\T5-2.WK1	
OPERATING UTILITY COSTS			Operating Costs ($) annual	Daily Operating Cost	
Electricity	2 watts/sf.	$0.059 /KW-hr	$6,013		
Fuel Allowance	n/a		$1,000		
Water/sewer	0.150 Gal/s.f.	$0.001 /gal.	$2,621		
Process Equipment	40 hp	$0.059 /KW-hr	$4,577		
SUBTOTAL			$14,212	$54.7	1.7%

LABOR (Incl. Burden, direct wage, fringes, taxes)		NET INCREASE FOR RDF PRODUCTION			ESTIMATED REVENUES	
Personnel		Salary $/HR	No.# of personnel	Daily Labor cost ($)		
1. Administrative	Supervisor	20	1	$160		
	Clerical/scalehouse	10	2	$160	Revenues for recyclables are calculated	
2. Production	Sorting Personnel	6	15	$720	in Table 5-4 Recoverable Material Value	
	Production equipment	10	1	$80	and entered into this spreadsheet as	
3. Shipping	Equipment Operator	10	1	$80	recyclables revenue	
4. Maintenance	Process Equipment	12	2	$192	RECYCLABLES REVENUE	$103,189
General Overtime allowance		10	1	$80		
Subtotal (Daily labor cost)			22	45.1% $1,472		

PARTS & SUPPLIES		Daily cost ($)		TRANSPORTATION COSTS ($80/TRIP TO TUCSON)	
1. Administrative	$25 /WK	$5		ASSUMING 200 TRIPS/YEAR	
2. Production	$5 /WK/EMPLOYEE	$22		ANNUAL TRANSPORTATION COSTS	$16,000
3. Maintenance	$10,000 /ANNUALLY	$27		NET RECYCLABLES REVENUE	$103,189
Subtotal (Daily avg. cost)		1.7%	$54	REVENUE PER TON RECEIVED	$5.3

WASTE TRANSPORT – DISPOSAL COSTS			Daily cost ($)	
1. Landfill reject	$25 /ton –	32.9 tpd		$823
2. Compost Disposal &/or Processing	$25 /load	26.8 tpd		$670
3. HHW Disposal	$50,000 /'yr.			$192
Subtotal (Daily avg. cost)			51.6%	$1,685

ESTIMATED DAILY OPERATING COST	100%	**$3,266**	ANNUAL (260 DAYS/YEAR) OPER. COST $849,125
ESTIMATED DAILY OPERATING COST PER TON RECEIVED		**$43.5**	
LESS ESTIMATED REVENUES GENERATED		**$5.3**	ANNUAL REVENUES $103,189
CONTRIBUTION TO TIP FEE PER TON RECEIVED ($/TON)		**$38.3**	NET OPERATING COST (ANNUALLY) **$745,936**

TABLE 5-4

RECOVERABLE MATERIAL VALUE

SCS ENGINEERS — COUNTY OF SANTA CRUZ MATERIAL RECOVERY FACILITY FEASABILITY STUDY — D:\10920 10\TASKS\MTLVALUE.WK1

SURVEY OF WHOLESALE BUYERS			WHOLESALE VALUE OF RECOVERABLE MATERIAL					
			COMMODITY AVG.	BUYER NO.1	BUYER NO.2	BUYER NO.3	AVG. ANNUAL VALUE	
MATERIAL DESCRIPTION	% by Wt.	T.P.D.	$/TON	$/TON	$/TON	$/TON	$	TONS
PAPER/PULP PRODUCTS	**29.2%**	**21.92**						
Newspaper	2.5%	1.88	$2.50	$20	N/A	N/A	$5,928	296
Cardboard	15.6%	11.70	$10	N/A	N/A	N/A	N/A	N/A
Magazines/Glossy	0.7%	0.53	N/A	N/A	N/A	N/A	N/A	N/A
Office/Computer Paper	0.9%	0.68	$122.50	N/A	N/A	N/A	N/A	0
Other Mixed Paper	9.5%	7.13	N/A	N/A	N/A	N/A	N/A	N/A
PLASTIC PRODUCTS	**7.9%**	**5.93**						
PET Bottles	0.4%	0.30	$50	N/A	$0	$50	$3,861	77
HDPE Bottles	0.7%	0.53	$110	N/A	$0	$80	$11,326	142
Other Plastics	6.8%	5.10	N/A	N/A	N/A	N/A	N/A	N/A
YARD WASTE	**11.1%**	**8.33**						
Misc. Yard Waste	11.1%	8.33	N/A	N/A	N/A	N/A	N/A	N/A
MISC. ORGANICS	**29.8%**	**22.36**						
Wood/Lumber	4.6%	3.45	N/A	N/A	N/A	N/A	N/A	N/A
Food Wastes	12.7%	9.53	N/A	N/A	N/A	N/A	N/A	N/A
Other Organics	12.5%	9.38	N/A	N/A	N/A	N/A	N/A	N/A
GLASS	**2.3%**	**1.74**						
Clear Glass Containers	1.6%	1.20	$5	N/A	N/A	$20	$4,680	234
Green Glass Containers	0.1%	0.08	N/A	N/A	N/A	N/A	N/A	N/A
Brown Glass Containers	0.5%	0.38	N/A	N/A	N/A	N/A	N/A	N/A
Other Glass Containers	0.1%	0.08	N/A	N/A	N/A	N/A	N/A	N/A
METALS	**6.7%**	**5.03**						
Ferrous Containers	1.1%	0.83	$75	$0	$54	$0	$10,670	198
Other Ferrous Metal	4.4%	3.30	N/A	$0	$20	$0	$16,180	809
Non-ferrous Metal (total)	1.2%	0.90	$530	$600	$600	$0	$50,544	84
Beverage Cans	0.5%	0.38						
Other Non-Ferr. Metals	0.7%	0.53						
MISC. INORG. MATL.	**6.6%**	**4.95**						
Misc. Inorganics	6.6%	4.95	N/A	N/A	N/A	N/A	N/A	N/A
OTHER WASTE	**6.4%**	**4.80**						
Other Waste	6.4%	4.80	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL	100.0%	75 TONS	TOTAL ESTIMATED ANNUAL VALUE OF RECOVERED MATERIAL				$103,189	1,840

TABLE 5-5

COST ANALYSIS SUMMARY
FOR THE CONSTRUCTION OF A MATERIAL RECOVERY FACILITY

SCS ENGINEERS — D:\1092010\TASK5\MRFSUM.WK1

PROJECT: Santa Cruz Feasability Study

LOCATION: DATE: 09/25/92

REVENUES	ANNUAL REVENUE SAVED
	$103,189

ESTIMATED OPERATING EXPENSES (Initial)	ANNUAL OPERATING COSTS
LABOR, EQUIPMENT, MAINTENANCE & DISPOSAL	$849,125

ESTIMATED CAPITAL COSTS	TOTAL CAPITAL COST
EQUIPMENT, ENGINEERING COSTS	$1,146,838
BUILDING CONSTRUCTION, ENGINEERING, INSTALLATION COSTS	$977,285
TOTAL	$2,124,123

COMPARISON OF FUNDS AVAILABLE TO ANNUAL PAYMENT

1	2	3	4	5	6
			4 % ESC.	2 % ESC.	Funds Required
YEAR	Engineering & Permit	Facility Capital Cost	Oper. Cost	REVENUE	Debt & Oper.
1	Included in Capital Cost	$2,124,123	$849,125	$103,189	$961,031
2	n/a		$883,090	$105,253	$992,932
3	n/a		$918,413	$107,358	$1,026,150
4	n/a		$955,150	$109,505	$1,060,740
5	n/a		$993,356	$111,695	$1,096,756
6	n/a		$1,033,090	$113,929	$1,134,256
7	n/a		$1,074,414	$116,207	$1,173,301
8	YEAR 2000 n/a		$1,117,390	$118,531	$1,213,954
9	n/a		$1,162,086	$120,902	$1,256,279
10	n/a		$1,208,569	$123,320	$1,300,344
11			$1,256,912	$125,787	$1,346,220
12			$1,307,189	$128,302	$1,393,981
13			$1,359,476	$130,868	$1,443,703
14			$1,413,855	$133,486	$1,495,464
15			$1,470,409	$136,155	$1,549,349
Subtotals		$2,124,123	$17,002,525	$1,784,487	$18,444,459
TOTAL ESTIMATED FACILITY COSTS OVER 15 YEARS			**$19,126,649**		

AMMORTIZED ANNUAL PAYMENT ON CAPITAL COST FOR 15 YEARS @	6%	$215,095

TIPPING FEE REVENUES		
WASTE RECEIVED ANNUALLY	75 TONS	19,500 TONS ANNUALLY PROCESSED
TOTAL REQUIRED TIP FEE REVENUE CONTRIBUTION PER TON RECEIVED		$49

SECTION 6

FACILITY PROCUREMENT METHODS

INTRODUCTION

This section includes an analysis of facility procurement methods considered appropriate for the County. The following specific procurement methods were analyzed.

- Contractual Arrangements for Facility Construction.
- Contractual Arrangements for Facility Operation.

There really only exists three recognized options with regard to facility contractual arrangements. These options are as follows:

- Publicly Owned - Publicly Operated.
- Publicly Owned - Privately Operated.
- Privately Owned - Privately Operated.

Completely public arrangements would be where the County owned and operated the MRF. Often standardized processing systems are utilized and satisfy the processing requirements of the government entity. This arrangement can be accomplished without difficulty and with all parties involved having a clear understanding of the contractual requirements.

Under public ownership and private operation, the County would provide the financing and guidance (via a consultant) with regard to the construction and system processing operations. The County would own the facility and would contract for design, construction, and operation. This type of arrangement would give the County more control of the facility than if it were totally private, but it relieves the County of the day to day operational requirements of the facility. This arrangement also allows the potential for the County to share in the revenues generated and the setting of tipping fees.

Under a full private arrangement, the private contractor assumes all the benefits, responsibilities and risks of the facility. This arrangement essentially puts the County out of the waste management and disposal business. It requires a significant risk on the part of the contractor and less on the County. Typically, flow control on the part of the County becomes a requirement of the contractor.

PROCUREMENT ALTERNATIVES

All three of these contractual arrangements have been used with both positive and negative results. The applicability of each option can vary based on local conditions.

The procurement options available to county and municipal governments include:

- A Traditional Architect and Engineer (A/E) procurement of contract documents, general contractor construction, and County operation of the facility.

- A Turnkey Approach that employs a single contract for the design and construction of the facility. Operation is performed by the County or another selected contractor.

- A Modified Turnkey Approach that hires a contractor to design, construct, and operate the facility for a specified period of time.

- A Full Service Approach using an expanded turnkey arrangement that expands the role of the contractor to include financing, marketing, and essentially all the risk and rewards associated with the facility.

Traditional Architect and Engineer Approach

Traditional A/E procurement is probably the most common method used by government entities. This type of procurement requires the selection of an A/E firm to perform the traditional design and development of contract documents, and another for the selection of a General Contractor to construct a facility. The advantages to this method include:

- The County would utilizes an A/E firm that is contracted to design a system and facility that is specifically customized to their requirements.

- The County would most likely operate a facility procured under this arrangement. If the County has the administrative capacity to take on this function, this can be a positive factor.

- The facility is typically constructed under highly competitive conditions with several contractors bidding for the construction work. Therefore, the County is able to receive the most for their money.

- The County would typically utilize the designing A/E firm for bid negotiations and construction management. This relieves the County of this responsibility and the A/E firm would typically enforce the requirements of the contract documents to the advantage of the County.

- The County would experience the financial rewards from the facility.

Disadvantages to this method include:

- The County bears essentially all the risk with regard to the costs and performance of the facility.

- The County must be capable of the cash outlay requirements for the facility.

Turnkey Approach

A "Turnkey approach" usually involves the selection of a consultant that develops and establishes the parameters of the project. Under this format, the consultant and/or the County draft a single turnkey Request For Proposal (RFP). A contractor is often prequalified from a Request For Qualifications (RFQ) process. The RFP includes design, permitting, construction, and start-up of the facility. In this arrangement, the County would normally own and operate the facility. In addition, the County would assume most of the risk not directly related to facility performance.

The advantages to this method include:

- The County may minimize overall costs. In this arrangement, an A/E firm is hired to establish parameters, while another A/E firm under the contractor's direction designs the facility.

- The County would most likely operate a facility procured under this arrangement. If the County has the administrative capacity to take on this function, this can be a positive factor.

- The facility is typically constructed under highly competitive conditions with several contractors bidding for the work.

- The County would experience the financial rewards from the facility.

Disadvantages to this method include:

- The County bears essentially all the facility costs and performance risks.

- The County must be capable of the cash outlay requirements for the facility.

- The County may experience an increase in overall costs. In this arrangement, an A/E firm is hired to establish parameters, while another A/E firm under the contractor procures the design. This arrangement is more susceptible to litigation due to misunderstandings and unclear facility requirements.

- More detail with regard to establishing acceptance criteria and enforcement is required.

Modified Turnkey Approach

A "Modified Turnkey" approach involves the selection of a contractor to design, construct, and operate the facility for a specified period of time. Under this arrangement the contractor assumes more of the risk related to the operation and construction of the facility.

This approach is expanded to include the marketing of the recovered products from the facility. In this arrangement, the contractor is paid a fixed capital cost for the design and construction of the facility. Then, either a cost-plus or a competitively bid fee is paid for operation and maintenance.

Performance incentives can be part of the contract negotiations to enhance both construction and operational factors. This usually involves the selection of a consultant that develops and establishes the parameters of the project. In addition, under this format, the consultant and/or the County draft a single turnkey RFP. A contractor is often pre-qualified from an RFQ process. The RFP includes design, permitting, construction and operation of the facility.

The advantages to this method include:

- The County may minimize overall costs. In this arrangement an A/E firm is hired to establish parameters while another A/E firm under the contractor designs the facility.

- The County would not be required to initially operate the facility. Under this arrangement, risks associated with the operation and performance are deferred to the contractor and can be a positive factor. The County does not have the administrative capacity to take on this function.

- The facility is typically constructed under competitive conditions with several contractors bidding for the project contract.

- The County would typically use the designing A/E firm for bid negotiations and construction management. This relieves the County of this responsibility and the A/E firm would enforce the requirements of the contract documents to the advantage of the County.

- The County would not experience the financial requirement associated with financing the facility.

- Through contract negotiations the County could share in the cost and revenues of the facility.

Disadvantages to this method include:

- The County may not get a facility that is designed and operated specifically as they would require.

- The project contract typically requires larger established waste handling firms. This will in-effect reduce the competitive requirements. In addition, bid evaluation becomes much more difficult due the availability of a variety of arrangements and processing technologies.

- The County typically would not share in any of the financial rewards from the facility.

- The County has little control of the facility operation.

Full Service Approach

A full service approach uses an expanded turnkey arrangement. This arrangement expands the role of the contractor to include financing, marketing, and essentially all the risks and rewards

associated with the facility. This method essentially has the same advantages and disadvantages as the modified turnkey approach, except the County would have even less control of the facility. A full service contractor would assume essentially all the major risks associated with the project and therefore deals with all the components of facility operation, revenues from tipping fees, revenues from the sale of recyclables, etc.

BEST OPTION RECOMMENDATION

It has been assumed that the County will most likely be working with a typical mixed waste processing system. For this type of system, there exists several manufacturers of standardized processing equipment. Thus, the requirement of a having a specific and customized processing system is not essential.

The primary engineering work related to this project would include the design, and the permitting of the building and associated environmental features. Oversight, review, and assistance in the selection of a standardized processing system is warranted and should be provided. Based on our review, the County has the administrative capacity to manage such a facility. Because of these and other related conditions and facts, a traditional procurement of the facility with County operation would be the best option. This type of arrangement would provide for the following:

- A cohesive arrangement with the existing landfill operations.
- A consolidation of solid waste processing operations for the County.
- A processing system that is standardized, yet somewhat customized to the specific requirements of the waste stream.
- A highly competitive facility bid process providing for the participation of several local construction contractors.
- Control of the tipping fee, marketing, and environmental requirements of the facility.
- The ability of the County to experiment with a pilot composting program that could eventually be expanded to include the complete compostable fraction of the waste stream.

This arrangement would require the County to finance and market the recyclables. However, as previously discussed, some of the materials recovered from the MRF may be useable directly by the County. In addition, flexibility could be designed into the facility and its operation to include the incorporation of limited source separated and commingled collection systems in the future.

Facility implementation would begin with finalizing the option to purchase the proposed site. Then, the development of more detailed "Permit Drawings" should be performed along with the collection of information on standardized processing systems applicable for use on this project. Then, a RFQ for final design/build services should be generated, or a consultant could complete detailed drawings of the facility and its related features along with contract documents. This

would set the stage to have two primary contractors on the project (1-Building Contractor and 1- Equipment Contractor). Prior to finalizing the building drawings, the equipment contractor would need to have been selected so appropriate features can be provided for the equipment.

The time required for implementation based on this scenario is estimated as follows:

Finalization of Land Option	2-4 months
Finalization of Applicable Zoning	2-4 months
Development of Permit Drawings and Documents	4-6 months
Analysis and Preliminary Selection of Equipment	(in above time span)
County and Regulatory Review Allowance	3-6 months
Finalized Building and Construction Contract Documents	3-4 months
Finalized Processing Equipment Drawings and Contracts	(in above time span)
Facility Construction	5-8 months
Process System Construction and Start-up	1-2 months

Initiation of the project to start-up is estimated at approximately 2 years. Certainly, fast-track implementation could be performed, cutting this time to approximately 1 year.

SECTION 7

DESIGN CONSIDERATIONS OF SOLID WASTE COMPOSTING FACILITIES

COMPOSTING FACILITIES

Introduction

A brief review of the feasibility and physical arrangements necessary for composting was performed. Potential composting arrangements could include systems for mixed solid waste composting that utilize stacked aerobic, rotary kiln, and/or windrow technologies. The costs of facility construction and operation typically are in excess of $40 per ton. Capital costs range from $2 million to $5 million depending on the preferred technology.

Literature on a typical stacked aerobic system provided by Riedel Waste Systems, Inc., is included in Appendix A of this report. A $13 million plant was constructed by Riedel that was designed to receive approximately 600 TPD of municipal solid waste. The facility included initial waste processing to recover recyclables followed by processing of the compostable portion of the waste stream to produce a useable compost product. This system utilizes a rotary kiln arrangement for processing the waste. This facility was recently closed due to public pressure regarding odors emanating from the facility. To allow the facility to reopen, additional capital costs of $3 to $4 million will be needed for odor control systems.

Literature on a typical indoor in-vessel type system provided by the Bedminster Bioconversions Corporation, is also included in Appendix A. This equipment uses a high technology, computer controlled systems with relatively low operating costs. The literature represents a co-composting system that utilizes all the MSW waste stream along with municipal sludge and yard waste. For the County, this type of facility would cost on the order of $4.0 to $5.0 million, it reportedly would receive and process both spoiled produce, yard waste, the MSW waste stream and possible municipal waste water sludge.

The location of such a facility could be either the Rio Rico Landfill site or a similar area with flat clear land away from congested areas. The physical layout of these facilities is normally specific to the technology used. However, for a full scale MSW composting facility, 5 to 10 acres would most likely be required.

Composting--

A capital intensive composting installation is not recommended for the County. Due to the uncertain contaminant level in the organic fraction of MSW coming from a MRF, a low cost pilot program approach would be most prudent at this time.

With approval from regulatory authorities, the landfill might also be a suitable location to experiment with sludge/yard waste or sludge/MSW composting, once the MRF is in place and if municipal sludge is available in large quantities.

Based on our review of the data available, none of the technologies requiring construction of a capital intensive facility would appear to be appropriate or cost effective for the County. Each of these technologies has experienced difficulties with regard to public acceptance and end market use. As transportation and landfilling costs continue to rise and composting technologies improve and become more accepted, a review of the cost effectiveness of composting and/or co-composting and the potential end use(s) may be warranted.

Recommendations

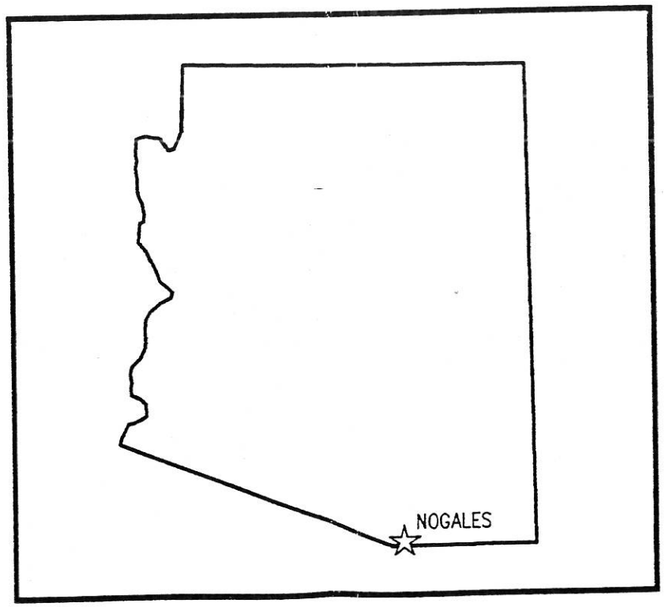
In view of the unknown constituents of the organic fraction from the MSW, it is recommended that the County initiate a pilot composting program. Using a pilot program approach, the necessary level of technology, operator skill, and associated end-user markets can be identified and developed as the need arises at minimum capital cost to the County. This approach is also recommended in order to determine the specific mix of input constituents (e.g., yard waste, wastewater sludge, and/or organic fraction of MSW from a MRF) that would be appropriate for the County, and the availability of reliable markets for the end-product(s). These determinations should be made prior to expending significant capital resources on a specific composting technology.

Because the County landfill often receives large volumes of spoiled produce, composting of this type of waste should be pursued. Composting this type of material has been shown to produce high quality compost. Companies such as Compost America specialize in this type of composting and the associated regionalization of this type of waste processing. They develop a program whereby they receive, process and market the compost. This situation lends itself well to owners sharing in this arrangement. A brochure from Compost America is included in the appendix of this report. Other companies exist that also provide these kinds of services and they should all be screened by a RFQ process prior to serious analysis.

SANTA CRUZ COUNTY, ARIZONA
MATERIAL RECOVERY FACILITY
FEASIBILITY STUDY

SYMBOLS & ABBREVIATIONS

- ROADS
- PROPERTY LINE
- TRAFFIC FLOW ARROW
- VEGETATED AREAS
- CHAIN LINK FENCING

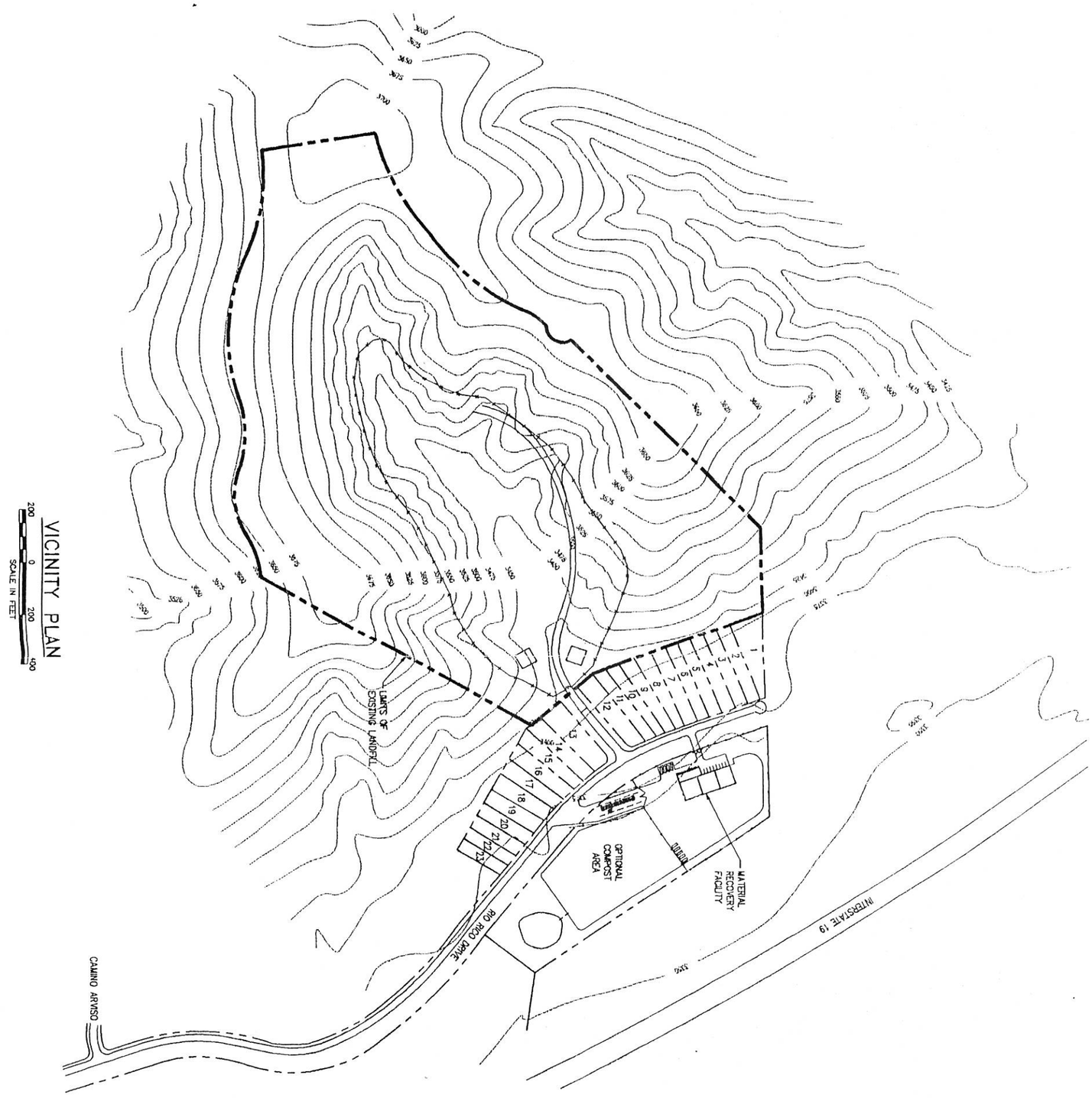


SHEET INDEX

DWG NO.	DWG. TITLE
0	COVER SHEET
1	VICINITY PLAN
2	SITE PLAN
3	FLOOR PLAN AND EQUIPMENT ELEVATION

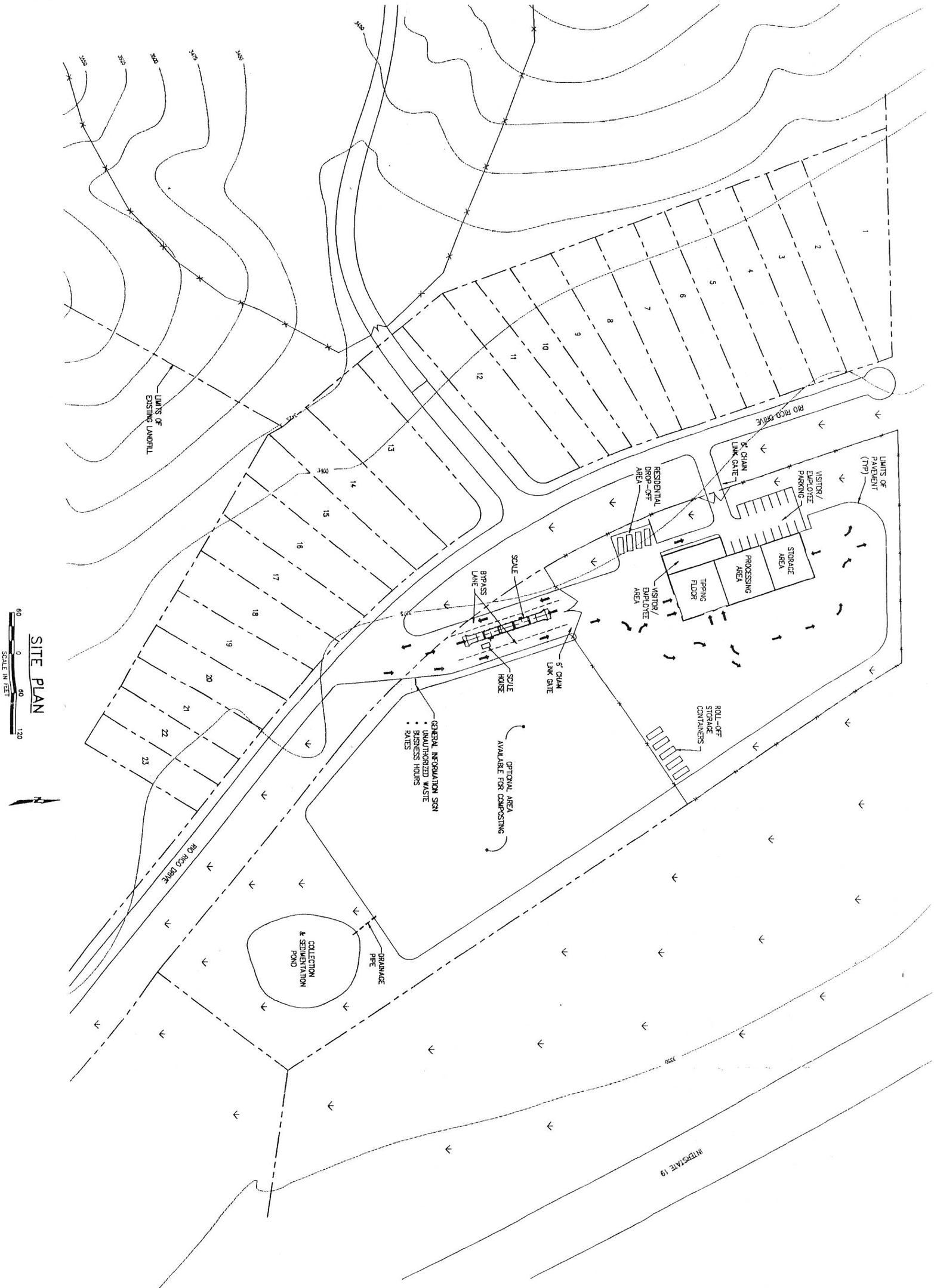
SCS ENGINEERS
CONSULTING ENGINEERS
10401 HOLMES ROAD SUITE 400
KANSAS CITY, MISSOURI 64131
PH. (816) 941-7510
FAX NO. (816) 941-8025

SCM01 1=200 9-25-92



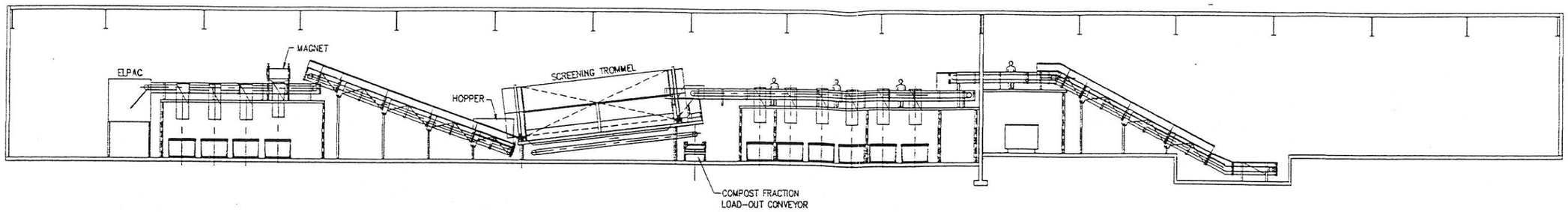
DRAWING NO. 1 of 3	SCALE: 1"=200'	DATE: SEPT. 1992	CADD FILE: SCM01	**SCS ENGINEERS** STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS 9400 HOLMES ROAD, SUITE 400, KANSAS CITY, MISSOURI 64131 PH. (816) 941-7010 FAX NO. (816) 941-8065 PROJ. NO. 10-92010.00 DSNR. BY: CEM; CHK. BY: PDN; CHK. BY: CEM; S/A RVW BY: JDW; APP. BY:	CLIENT SANTA CRUZ COUNTY 2150 N. CONGRESS DRIVE NOGALES, ARIZONA 85621	SHEET TITLE: VICINITY PLAN PROJECT TITLE: MATERIAL RECOVERY FACILITY FEASIBILITY STUDY	REV.	DATE	DESCRIPTION	CK. BY

SCM02 1=60 9-25-92



DRAWING NO. 2 of 3	SCALE: 1"=60'	DATE: SEPT. 1992	CADD FILE: SCM02	**SCS ENGINEERS** STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS 9400 HOLMES ROAD, SUITE 400, KANSAS CITY, MISSOURI 64131 PH. (816) 941-7810 FAX NO. (816) 941-8026	CLIENT: SANTA CRUZ COUNTY 2150 N. CONGRESS DRIVE NOGALES, ARIZONA 85621	SHEET TITLE: SITE PLAN PROJECT TITLE: MATERIAL RECOVERY FACILITY FEASIBILITY STUDY	REV. / DATE / DESCRIPTION / CK. BY

PROJ. NO. 10-92010.00 | DES. BY: PDN | Q/A REV BY: JOW | DRG. BY: CEN | CHK. BY: CEN | APP. BY:



EQUIPMENT ELEVATION

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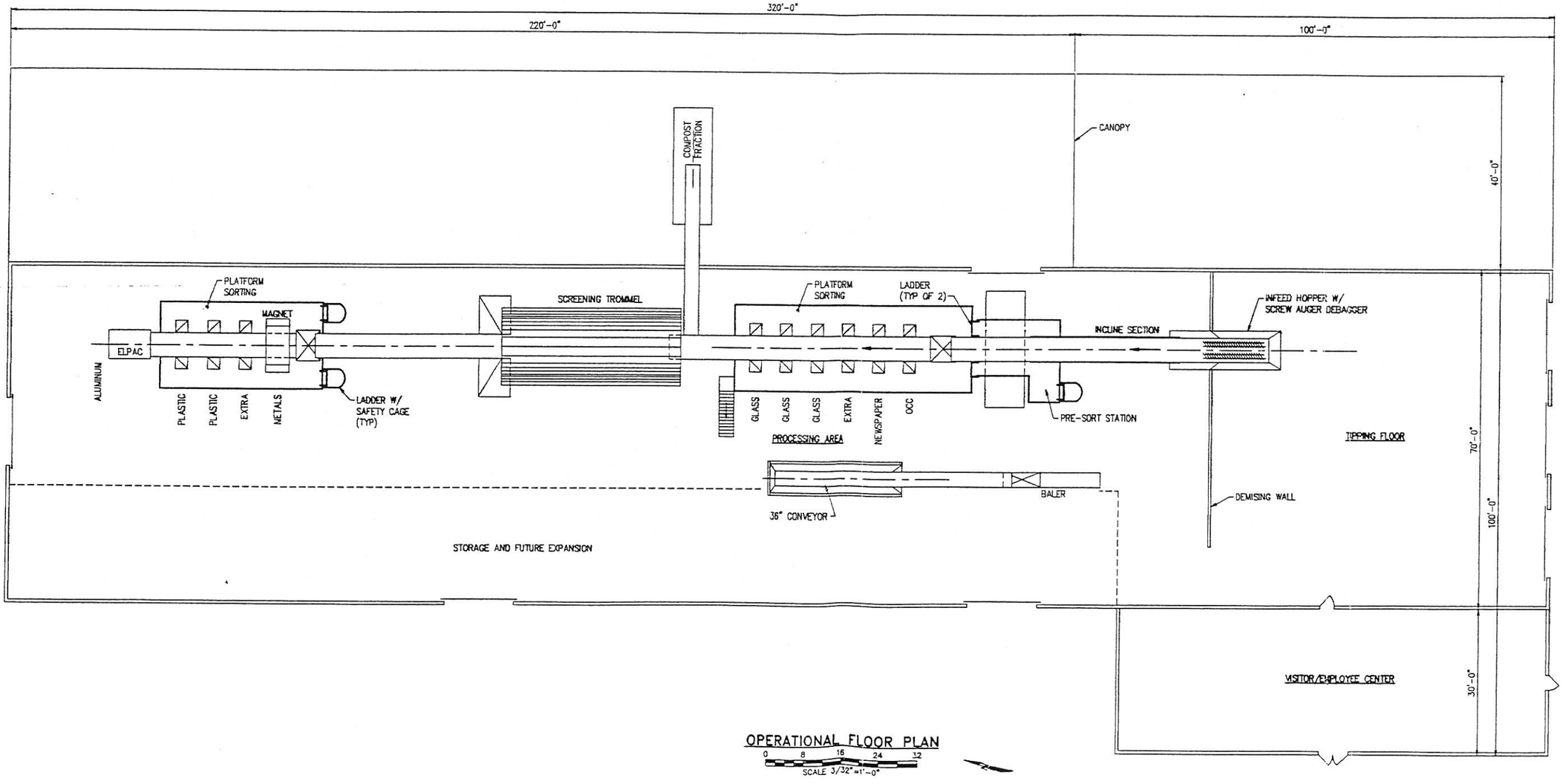

OPERATIONAL FLOOR PLAN

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REV.	DATE	DESCRIPTION	CK. BY

SHEET TITLE: FLOOR PLAN AND EQUIPMENT ELEVATION

PROJECT TITLE: MATERIAL RECOVERY FACILITY FEASIBILITY STUDY

CLIENT: SANTA CRUZ COUNTY
2150 N. CONGRESS DRIVE
NOGALES, ARIZONA 85621

SCS ENGINEERS
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8400 HOLMES ROAD, SUITE 100, KANSAS CITY, MISSOURI 64131
PH. (816) 941-7700 FAX NO. (816) 941-8486

PROJ. NO. 02010.00
DSN. BY: CEN
DRWN. BY: PDM
CHK. BY: CEN
QA/QC BY:
APP'D BY:

CADD FILE: SCM03

DATE: SEPT. 1992

SCALE: 3/32"=1'-0"

DRAWING NO. 3 of 3

SCALE 1=128 9-21-92

EarthLife

"What is it?"

EARTHLIFE sludge compost has gone through a process in which sewage sludge and a bulking agent, usually wood chips, are mixed and then aerated, resulting in a rise in temperature (a minimum of 3 days at 131+F) from microbial activity. The raw materials are transformed into EARTHLIFE, a high quality, environmentally safe, EPA approved soil product for agronomic use.

Compost is produced under a stringent set of regulations which are established and monitored by the environmental protection agency of the state in which the compost is produced. This assures every customer of receiving the cleanest, safest product available. Any compost marketed under the EARTHLIFE name must also meet company standards for nutrient content, phytotoxicity, physical integrity, pH, and consistency.

Each production plant, due to its unique composting method, produces compost that looks slightly different from other plants. This is to be expected. Compost varies slightly in color and texture from one plant to the next just as peat moss and topsoil varies from batch to batch. Variations occur due to differences in the sludge dewatering process, bulking agent used, composting method, and curing method; however, all products marketed under the EARTHLIFE brand name will perform the same agronomic function unless specifically stated. For specifics please consult our technical literature.

The important characteristics of EARTHLIFE, unlike varying batches of topsoil, are extremely consistent within each compost facility. These characteristics are:

- High organic matter content
- EPA approved pathogen destruction
- Consistent pH (6.6 - 7.7)
- Rich source of Magnesium and Calcium
- 1% - 2% Nitrogen and Phosphorus content
- Micronutrient source (Fe, Mn, S, Zn, Ni, Cu, B, etc.)
- Low Cadmium content

"Why should I use it?"

- EARTHLIFE adds much needed organic matter to the soil.
- Tests prove that plants, trees, shrubs and turf grown in EARTHLIFE amended soil develop more extensive and active root systems.
- EARTHLIFE helps soil retain moisture, yet at the same time promotes good drainage.
- Because EARTHLIFE contains a significant amount of micronutrients there is no need to purchase these costly supplements as an additive to your commercial fertilizer. Micronutrient availability is pH related.
- EARTHLIFE improves ion exchange capacity and, therefore, nutrient retention capacity of soil.

"How and where should I use it?"

- In general, EARTHLIFE is used to amend any soil before planting grass seed, shrubs, sod, flowers or trees.
- Incorporate EARTHLIFE into the top 6" of soil before starting new turf.
- Use EARTHLIFE in the backfill when planting trees.
- Incorporate EARTHLIFE into soil when preparing flower beds.
- Sod planted in EARTHLIFE amended soil quickly establishes a deep, fibrous root system.

Technical data sheets on specific uses of compost are available from your local sales representative.
Compost is currently used by some farmers for crop production. Some state regulations prohibit its use on homeowner edible crops.

EarthLife

COMPOST AVERAGE ANALYSIS RANGE

Sewage Sludge Compost produced at different plants will vary with respect to pH, micronutrient content, organic matter and physical consistency; however, all EARTHLIFE Sludge Compost products are consistently within the ranges listed here.

CONTENT	LOW pH SLUDGE COMPOST	HIGH pH SLUDGE COMPOST	ENRICHED LEAF COMPOST
Nitrogen (N)	1.6 - 2.1%	1.5 - 1.7%	1.1 - 2.1%
Phosphorus (P)	.75 - 1.3%	.15 - .90%	.04 - .09%
Potassium (K)	.15%	.15%	.03 - .04%
Iron (Fe)	1.4 - 1.9%	2.5 - 3.5%	.1 - .2%
Calcium (Ca)	1.2 - 1.9%	10.7 - 11.7%	9.8 - 10.8%
pH	5.6 - 7.1	7.2 - 7.7	7.5 - 7.9
Organic Material	60 - 80%	43 - 63%	26 - 32%

HEAVY METALS OR ESSENTIAL TRACE ELEMENTS?

By Francis R. Gouin, Ph.D.

Introduction

Manganese, zinc, copper, boron, molybdenum, aluminum, and iron when blended and manufactured as: "FTE", "Esmigran", "Micromax", and other popular commercial materials are called essential trace elements. However, when these same elements plus nickel, chromium, lead, mercury and cadmium are found in sewage sludge or sewage sludge compost, they are called heavy metals. "Essential Trace Elements" have scientific appeal while "heavy metals" projects a dirty, objectionable connotation. Some of these metals are not considered essential but are found in sewage sludge in varying amounts depending on the source and the method of processing.

It has now been shown that the lead found in vegetable crops and in surrounding vegetation is not absorbed by the roots. There is conclusive evidence that the lead found in plants is from leaded gasoline. There is strong evidence that as leaded gasoline sales decrease so are the levels of lead being measured in plants. Control studies have shown that lead found in the soil is not absorbed by the roots. The same has been found true for mercury.

Cadmium: Controlling Uptake

At the present time cadmium is the only metal that is absorbed by plants that is not an essential trace element. Cadmium is a metal that is added to pigments to minimize oxidation. It is also metal that is found in many native soils. *Farmers have been adding large quantities of cadmium to their soil for years when applying phosphate fertilizers.* Cadmium is a contaminant of phosphate and researchers have reported levels in excess of 300 PPM in many of today's commercial sources of phosphorus. However, this contamination by cadmium is seldom mentioned and fertilizer manufacturers would rather not mention it.

Cadmium levels in sludge used in composting are constantly monitored, must be recorded, and are tightly regulated. Only sludges with low levels of cadmium can be used in composting. In contrast, cadmium levels in commercially available phosphorus are not controlled at all.

The absorption of cadmium by plants is controlled by: species, soil, organic content, soil pH, and fertility levels. Species of plants such as tobacco and swiss chard absorb cadmium when levels in the soil are high and soil organic matter, pH, and nutrition levels are low. Studies conducted at the University of Maryland with radishes reported that when grown in an old agricultural soil, roots and leaves of radish plants at a pH of 5.0 contained almost 2.5 times more cadmium than similar plants grown in a potting mix consisting of dredging from Baltimore harbor blended with 10% compost made from Blue Plains sewage sludge with the pH adjusted to near that of the agricultural soil. Researchers who have done extensive studies with heavy metal uptake readily admit their conclusion: *the absorption of cadmium in mineral soils is easily controlled by raising the pH above 6.2.* Cadmium is made insoluble by pH's above 6.2. The organic matter in compost further reduces cadmium availability.

The composting of sludge with bulking agents further reduces the amount of cadmium by dilution. In EarthLife, decomposing woodchips comprise more than 1/3 of the organic matter. Another major factor of safety when using compost is that soils amended with compost tend to have a more stable pH than mineral soils that are limed with agricultural grade limestone.

4140 SKYRON DRIVE · DOYLESTOWN, PENNSYLVANIA 18901 · (215) 348-9288

Is Heavy Metal Accumulation In Nurseries Possible?

Nurserymen who grow plants in the ground and sell them with balls of soils around their roots should be the last to concern themselves with the accumulation of heavy metals in their soils. With the harvest of each acre of field grown nursery stock, nurserymen remove 150 to 200 tons of topsoil. Since it is not recommended that compost levels exceed 50 dry tons per acre per application between crops, ***it is highly unlikely that there could ever be an accumulation of metals in such soils.*** It would literally be impossible to over-load such a soil under those recommendations. However, by using compost as a soil amendment between crops, such soils could be kept productive for an indefinite period of time. At the present time nursery soils start losing their productivity after the second or third harvest. In many old nurseries, it is not uncommon to step down into a field that has been in continuous production for many years.

Nickel And Chromium

Two other metals that were once considered dirty heavy metals but are now considered essential trace elements are nickel and chromium. Recent studies conducted at Cornell University have reported that nickel is essential for nitrogen fixation by legumes and is essential for disease resistance. Leguminous species such as locust, wisteria, clover and alfalfa cannot fix atmospheric nitrogen in the absence of nickel. Furthermore, leguminous and non-leguminous plants are more resistant to diseases when there is an adequate amount of nickel available. Nickel is one of those trace elements that have not as yet been incorporated into commercially formulated trace elements used by commercial growers. Chromium has also been found to be essential for the proper function of enzyme systems in plants. Chromium is also an essential trace element in the enzyme system of man and animal.

Conclusion

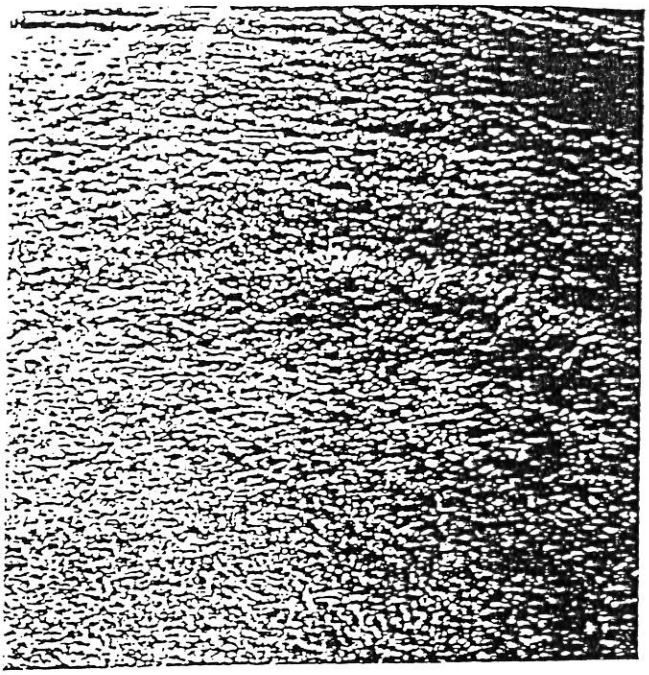
When one examines the nutrient content of compost made from residential sewage sludge, and as the nutrition of plants and animals undergoes more careful evaluation, it becomes increasingly evident that ***compost made from residential sludge probably provides a better nutritional balance than synthetic materials now formulated.*** Although there is no disputing with the term heavy metals, it is safe to say that the majority of them can be classified as essential trace elements. Non-essential heavy metals are either not absorbed by the roots of plants, or their availability are easily regulated by organic matter content and pH.

For information and reprints, contact:

EARTHLIFE Sales Company Doylestown, PA (215) 348-9288

FROM WASTE TO LAWN CARE RESOURCES

BY W.H. MITCHELL



Organic waste that was once squandered on landfills in the state of Delaware and the city of Philadelphia is now being converted into fertilizers for the lawn care industry.

If you travel south on the New Jersey/Delware Turnpike, look to the western shore of the Delaware River from the top of the Memorial Bridge. Looming up out of the once pristine Delaware marsh is a four million ton pile of northern Delaware waste. This miniature 65-foot mountain is a monument to our wastefulness. It seems stable enough, but experts say when it reaches a height of 70 feet it will start moving laterally into the Delaware River.

In 1970, then Governor Russell Peterson and the Delware General Assembly recognized the need for alternatives to landfills to protect our groundwater, since it accounts for 70 percent of our water requirements. Through their efforts, a far-reaching research and development program was initiated. Now, 15 years later, northern Delaware has a brand new $100 million facility for co-processing municipal waste.

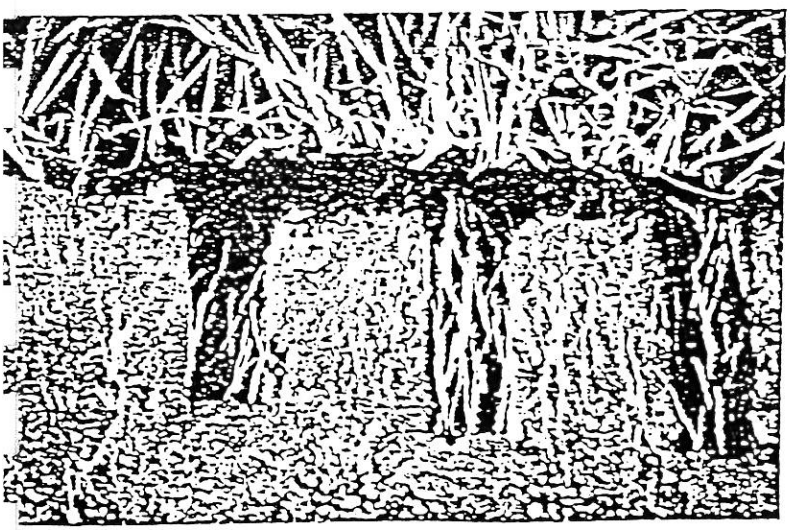
It is designed to handle the nine million tons of solid waste and two million tons of sewage sludge (20 percent solids) generated over the next 20 years by the 400,000 people who live in the region. Much of this waste will be processed and sold, which will take the pressure off existing and new landfills. With help from this new facility, it is estimated that the state will have met its landfill needs for the next 40 years.

The waste-to-resource program is turning out glass, ferrous metals and aluminum, for which there are ready buyers. Soon, steam and electricity will be produced for use in powering the plant, with the surplus sold to local industries. Just starting up is the composting process which will turn out a series of humus-based fertilizers as well as a lightweight, absorbant mulch that can be used in hydroseeding.

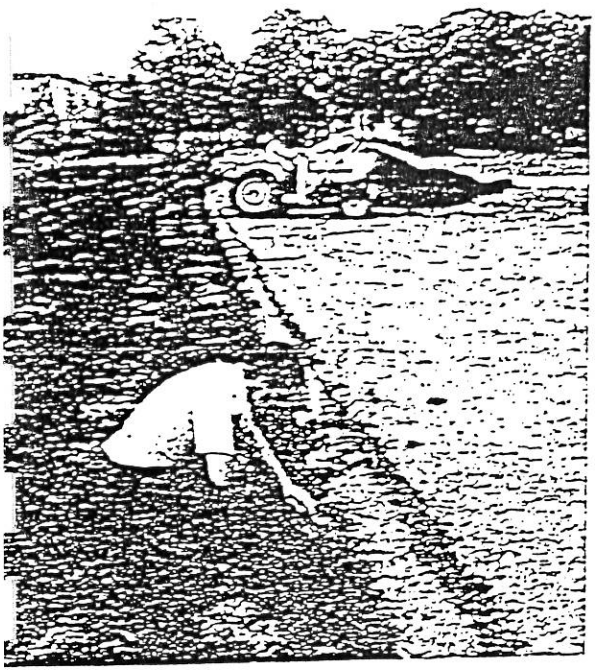
The conversion of solid waste and sewage (two to one ratio) to compost takes place in 100-foot diameter digestion vessels where the environment can be reasonably well controlled and odors trapped. Under forced aeration and constant agitation of the waste products, it takes about seven days to complete the composting process. Temperatures in the 150- to 170-degree Fahrenheit range destroy pathogens. The finished compost is relatively uniform because of the large size of the digesters and the constant mixing of the waste. This also facilitates quality control.

After seven days in the digesters, the humus is conveyed to drum-type driers where it is flash-dried at 300 degrees. It then moves through a series of milling, pelleting and crumbling processes on the way to becoming a family of marketable products called Turflife [3] and Hydrolife [3].

Turflife is a humus-based fertilizers containing 50 to 75 percent organic crumble, by weight. Plant nutrients contained in the humus crumble are supplemented from a wide choice of water-soluble and slow-release fertilizer materials. The basic fertilizer will be 6-2-4, consisting of 75 percent crumble on a weight basis and containing



ification holes backfilled with Earthlife topdressing to improve ot development.



Below is a renovated plot of ground at Swarthmore College, Swarthmore, PA, six weeks after treatment. At left, the same area, six weeks earlier, is being renovated using a four-step program involving Roundup for knockdown, a Ryan aerifier to open up the compacted soil, topdressing with 1/2-inch of screened Earthlife and band seeding of a perennial ryegrass blend with a Jacobson vertiseeder.

about 15 percent organic nitrogen. This will also be available as a weed and feed specialty product. In addition, there will be 10-0-5 and 20-0-5 for use where soil phosphorus levels are high and 5-10-5 for use in turfgrass establishment. All products will be made by a bulk-blending process and will be marketed in bags and bulk.

Hydrolife is produced from composted waste which is passed through a series of screening and fluffing operations designed to maximize its water absorbancy. Its dark brown color facilitates use in hydroseeding without the addition of a marking dye. The product will be packaged with a bonding agent and fertilizer for convenient use by hydroseeders.

A few miles up the Delaware River, the city of Philadelphia is making a daily conversion of about 500 million gallons of sewage into a broad spectrum of products that are useful to the turfgrass industry. Again, the process involves basic, time-proven principles of composting. Unlike Delaware, which uses solid waste as a bulking agent, the Philadelphia plant uses wood chips to facilitate movement of air through the waste during composting.

Instead of closed vessels, they use windrow composting with air pulsed through perforated tubing placed in the base of 12- by 100-foot pyramid-shaped piles. Composting goes on for 20 to 30 days. The piles are then broken down and the humus stockpiled in a holding area for an additional 30 days. The humus is then run through a 1/2-inch rotary screen to refine the product while recovering the large wood chips for recycling.

The remaining humus, called Earthlife ®, is the basic product marketed from the Philadelphia waste recovery plant. With additional screening and mixing with sand and other materials, several useful products are produced. These products are handled in bulk with all of the cost advantages associated with high volume production.

This is a brief review of the waste recovery program which has been set in motion here in the Delaware Valley. Valuable products are being produced and they are creating interest in the marketplace. The waste-to-resource concept is being accepted by the public because it is a very good buy.

W.H. Mitchell is professor emeritus at the University of Delaware, Newark, DE.

Waste to Resource Products Produced in Philadelphia

Earthlife.
Composted humus passed through a 1/2-inch screen can serve as a:
- Substitute for topsoil, when incorporated, for soil improvement in all types of new construction from industrial parks, housing developments and athletic fields to home lawns.
- Topdressing for athletic fields.
- Component in potting mixtures for container stock.
- Component in overseeding and pregermination mixes.

Earthlife Construction Mix.
Screened Earthlife and approved sand is ideal for construction of Golf tees, golf greens, bowling greens, athletic fields and other all-weather playing surfaces.
Unscreened Earthlife which contains large wood chips and sand, is being used for soil improvement where the requirements are not demanding and emphasis is on low cost.

Earthlife Topdressing Mix.
Re-screened through 1/8-inch mesh and approved sand is ideal for:
- Topdressing all fine turf areas.
- Divot repair.
- Topdressing all turf areas originally constructed with Earthlife construction mix.

EarthLife Sales Company

"Sports Turf Specialists"

ATHLETIC FIELDS: THE TOTAL RENOVATION PROCESS

Technical Information by
William H. Mitchell, Ph.D., Emeritus Professor of Agronomy,
University of Delaware

PROCEDURE

Renovation is most often required in the heavy wear area between the hashmarks but it may be needed for the entire field. Although the general pattern of wear will prevail, each field will have its own character and should be treated accordingly. The procedure for total renovation of fields is as follows:

1. The renovation process will involve either rototilling or discing to destroy vegetation and incorporate soil amendments. Normally herbicides will not be needed; however, if the field is infested with perennial weeds such as wiregrass, quakgrass, sheep sorrel, or Canada thistle, which mechanical tillage will not control, the area should be sprayed with Roundup at a concentration of 2 quarts per acre 5 to 10 days prior to all other renovation operations.

2. Apply 2 to 3 inches (4 to 6 truckloads) of EARTHLIFE Compost. Spread evenly with a manure spreader or other suitable equipment.

3. Add limestone, if necessary, to adjust the soil pH to the 6.5 to 7.0 range.

4. Incorporate EARTHLIFE to a depth of 4 or 5 inches with a disc or rototiller.

5. Smooth and firm the modified soil with a York rake with tines angled to move the soil toward the center of the field to re-establish the field crown. Some hand raking may be required, especially if incorporation is done with a disc.

6. Seed with a cultipacker-type seeder using one of the following seed mixtures:

MIX NUMBER 1

- 80% Tall Fescue (improved variety such as Falcon, Rebel or Houndog)
- 15% Fine Textured perennial ryegrass (improved variety such as Palmer, Citation or Pennfine)
- 5% Kentucky Bluegrass (Kenblue, Baron, Touchdown or other improved variety)
- Seed at 150 to 200 lbs./acre

OR

MIX NUMBER 2

- 85% Kentucky Bluegrass
- 15% Fine Textured perennial ryegrass
- Seed at 100 to 150 lbs./acre

4140 SKYRON DRIVE · DOYLESTOWN, PENNSYLVANIA 18901 · (215) 348-9288

TIMING

The ideal time to seed is between August 15 and October 15. However, the fields are likely to be heavily used for football games and other activities during this period. It may therefore be necessary to delay soil preparation until November or following the final game of the season or, if this is not possible, until early next Spring. An alternate schedule would be as follows:

1. Complete steps 1 through 5 above immediately following the final game of the season, if possible. You may also want to take this time to:

   a. Smooth the field
   b. Restore the crown
   c. Fill in depressions using a mix consisting of 50% EARTHLIFE and 50% soil. (Never fill with EARTHLIFE alone.)

2. Seed as soon after March 1 as soil conditions will permit.

By following this procedure you should produce a field with turf sufficiently established to permit graduation exercises in the Spring, and by Fall it should be in excellent condition for general use.

PARTIAL RENOVATION (Top Dressing Only)

On less used outer portions of the playing field or on fields where 50% or more of the surface is covered with desirable grasses a less aggressive renovation process may be desired.

1. Add limestone to adjust soil pH to the 6.5-7.0 range.

2. Aerify heavily (2 or 3 passes) with an aerifier equipped with 3/4 inch spoons.

3. Apply approximately 1/2 inch of EARTHLIFE. Spread with a manure spreader or other suitable equipment.

4. Smooth the area with a York rake (if necessary) followed by a steel mat, weighted section of chain link fence or comparable device to break up cores and backfill holes.

5. Seed with a vertiseeder using a multi-directional seeding pattern to insure proper seeding rate and uniformity of seeding.

6. Select a seed mixture that most closely resembles the mix originally used on the field. Should you desire to introduce a new species, such as tall fescue or perennial ryegrass, make sure to vertiseed the entire field to avoid a patchy appearance.

EarthLife Sales Company

"Landfill Vegetation Specialists"

LANDFILL VEGETATION PROCEDURES

by William H. Mitchell, Ph.D.

Background

The principal objective in vegetating landfills is to develop a cover that will minimize erosion, support vegetative growth, be attractive and economical. The key step to achieving a good vegetative cover is to produce an acceptable growing medium for grass. Well established grass will stop erosion, muffle noise and make the area aesthetically pleasing. By using locally available material for the growing medium costs can be kept to a minimum.

Real topsoil is scarce and very expensive hence the reason for up-grading low cost subsoil with composted anaerobically digested municipal sludge (Earthlife). University and government tests have shown that compost modified subsoil is an excellent long term growing medium for grass or other ground covers.

Clay caps are usually very acidic and highly infertile so the vegetating process will involve a number of chemical as well as physical soil modification steps. To be most successful in vegetating a landfill all of the turf establishment steps should be clearly identified and a time frame established so that the various operations will be timely and in proper sequence.

Detailed Procedure

1. Test soil (subsoil, sand, etc.,) for pH and nutrient levels.

2. General recommendations for lime and fertilizer will involve the use of 2 tons per acre of dolomitic limestone and 1,000 pounds per acre of a starter fertilizer. When diagnostic tests indicate a need to deviate from the general recommendations for lime and fertilizer contact should be made with a crop production specialist such as Dr. Robert Duell, Soils and Crops Department, Lipman Hall, Cook College, New Brunswick, New Jersey 08903 (201-932-8926).

3. Limestone should be applied, if possible, well in advance of the time of seeding (2 to 4 weeks) since it acts slowly in neutralizing soil acidity. It should be truck spread by the limestone supplier.

4. Apply a starter fertilizer with a spinner-type applicator.

5. Apply a minimum of 2 inches of anaerobically digested municipal sludge compost (Earthlife) using a manure spreader or other suitable equipment.

6. Incorporate limestone, starter fertilizer and Earthlife into the subsoil or sand with a disc to a depth of 4 to 6 inches. Operate disc on the contour or perpendicular to the slope as this will minimize run off and soil erosion.

7. Level the seed bed with a leveling plank pulled behind the disc, with a York rake or other suitable earth moving equipment. Perform all operations on the contour or perpendicular to the slope.

8. Choose one of the following methods of seeding based on needs and location:

a. When the area to be seeded is general flat and easily accessible and presents no safety hazard to tractor operator, seeding can be be done with:

(1) a drop-type cultipacker seeder (Brillion);

(2) a spinner type seeder followed by a corrugated roller should be done across or perpendicular to the slope. Firming can also be accomplished by a dozer using the "tracks" to firm. In this case the dozer should be operated parallel to the slope or up and down.

(3) hydroseed using a hydromulch.

b. When the area to be seeded is steep, inaccessible and rough and seeding with standard ground equipment would constitute a safety hazard to the tractor operator, work should be done with a hydroseeder using a hydroseeding mulch. If hydroseeding is not used or if additional soil stabilization or moisture retention is needed, the seeded area should be mulched with straw at one half ton per acre and over sprayed with a tackifier.

9. Seeding Dates:

a. The optimum time to seed is as early as possible during the period August 15th through October 15th.

b. If seeding must be delayed until spring, seed March 15th and complete project by May 15th. It must be stressed that seeding outside of these periods will cause reduced germination; excess heat stress, disease, etc.

10. The seeding rate should be 40 to 200 pounds per acre, depending on seeding method, quality of the seedbed and species to be seeded.

11. Seed with one of the following seed mixtures:

a. Tall Fescue (Ky 31) 90%
Ky Bluegrass 10%
(Kenblue, Park, Arboretum, Troy or Delta)
Seed at 100 lbs./acre (2.5 lbs./1000 Sq.Ft.

b. Tall Fescue (Ky. 31) 90%
Lespedeza (Senicia) 10%
Senicia is a valuable source of seeds for birds.
Seed at 200 lbs/acre (4.0 lbs/1000 Sq.Ft.)

c. Hard Fescue (Reliant) 90%
Perennial ryegrass 10%
(Pennfine, Palmer, Premier)

d. Hard Fescue (Reliant) 85%
Perennial ryegrass 5%
(Pennfine, Palmer, Premier)
Lespedeza (Sericia) 10%
Seed at 100 lbs. per acre (2.5 lbs./1000 Sq.Ft.)

e. Weeping lovegrass 10%
Lespedeza (Sericia) 90%
Seed at 40 lbs. per acre (1 lb./1000 Sq.Ft.)

Seeding rates should be considered minimum rates for relatively ideal conditions.

STATE OF NEW JERSEY
DEPARTMENT OF TRANSPORTATION
COMPOST SPECIFICATIONS

COMPOSTED SEWAGE SLUDGE

Composted sewage sludge shall consist of a stabilized mixture of wood chips and sewage sludge processed according to New Jersey Department of Environmental Protection "Interim Guidelines on General Conditions for the Processing and Distribution of Sewage Sludge Compost". All composted sewage sludge shall be obtained from facilities operating in compliance with a valid New Jersey Pollutant Discharge Elimination System permit for the composting of Sludge, or from facilities operating under NJDEP approved Memorandums of Agreement. The compost product must be registered with the New Jersey Department of Agriculture in compliance with New Jersey Commercial Fertilizer Soil Conditioner Act of 1970.

The compost shall have the following characteristics:

- average water content shall not exceed 55% by weight

- minimum organic content of 50% by weight

- a minimum pH of 6.0

- all compost shall be screened

Compost not meeting these requirements will not be accepted.

All shipments of composted sewage sludge shall be accompanied by delivery slips with certified weight and name of producer and/or supplier which shall be furnished at the time of delivery.

"12 Good Reasons Why

EarthLife Compost

Should Be In Your Budget"

1. Topdress your fairways.
2. Rebuild worn or undersized tees.
3. Backfill newly planted trees.
4. Mulch your flower beds.
5. Make your own topsoil.
6. Mulch your shrub beds.
7. Grow healthy vigorous turf under the most difficult conditions.
8. Grow your sod nursery.
9. Rebuild or make new greens.
10. Fill your flower boxes with growing mix.
11. Rejuvenate and strengthen the tops of bunkers.
12. Topdress your tees.

For technical information on any of the above uses, please contact:

William Filmyer
EarthLife Sales Company
(800) 327-8454

EarthLife Sales Company

"Golf Course Turf Specialists"

GOLF COURSE TEES AND FAIRWAYS: TOPDRESSING AND THATCH CONTROL

Technical Information by
William H. Mitchell, Ph.D., Emeritus Professor of Agronomy,
University of Delaware

A golf course covered with healthy grass provides a safer, substantially more functional playing surface. A regular program of aerification followed by topdressing with *NEW* EARTHLIFE FINE will help to:

- Control thatch;
- Promote more vigorous growth;
- Reduce compaction;
- Allow oxygen into the root zone;
- Encourage water movement into the soil; and
- Supply nutrition.

TOPDRESS PROCEDURE

1. Add limestone to adjust soil pH to the 6.5-7.0 range.
2. Apply 1/4 to 1/2 inch of EARTHLIFE FINE. Spread with a manure spreader or other suitable equipment.
3. Aerify heavily (2 or 3 passes) with an aerifier equipped with 3/4 inch spoons.
4. Smooth the area with a York rake (if necessary) followed by a steel mat, weighted section of chain link fence, or comparable device to break up cores and backfill holes.
5. Seed with a vertiseeder using a multi-directional seeding pattern to ensure proper seeding rate and uniformity of seeding. Select a seed mixture that most closely resembles the mix originally used on the field.

Should you desire to introduce a new species, such as tall fescue or perennial ryegrass, make sure to vertiseed the entire field to avoid a patchy appearance.

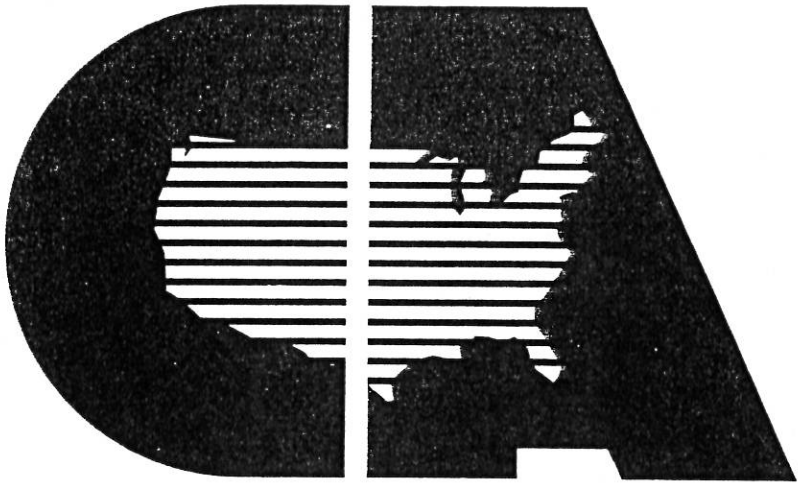
THATCH CONTROL

A *little* thatch, or at least the softness or sponginess that it imparts to a playing surface, is desirable. It "holds" a golf ball on the green and it softens ground impact. *Little* is the key word, however. Thatch becomes a problem when it accumulates to a half inch or more. It may limit rooting of grass, it becomes a hide-away for some insects, and it contributes to the development of several destructive diseases.

GOLF COURSE TEES AND FAIRWAYS: TOPDRESSING AND THATCH CONTROL by William H. Mitchell, Ph.D.

Thatch production is part of a very natural process. In simple terms, grass roots, leaf bases and clippings are produced faster than they rot, decay or otherwise decompose. When the balance tips toward thatch accumulation rather than decay, the first step in control is to look for the causes of the imbalance. The causes often involve factors which control the activity of microorganisms. High on the list of contributing factors are high soil acidity, soil compaction and poor aeration. Most microorganisms function best in moist, well aerated soil with a pH of 6.5 to 7.0. The carbon/nitrogen ratio should be 25:1 or 30:1. Since turfgrass roots and clippings contain about 40 percent carbon, the soil/organic matter mix must contain 1.2 to 1.4 percent nitrogen to achieve the correct carbon/nitrogen ratio and rapid organic matter decay.

The most effective way to control thatch is to follow a system involving liming, fertilization, aerification and topdressing. EARTHLIFE has a pH of 6.5 to 7.5 and contains from 1.0 to 2.0 percent nitrogen. Therefore, on these two counts it's the near perfect topdressing material. By mixing EARTHLIFE with soil cores that have been removed by an aerifier or coring machine, you've provided an ideal micro-environment for thatch decay organisms. The EARTHLIFE-soil mix will inoculate the thatch layer with microorganisms and it will help to achieve the good soil-thatch contact which is so essential for moisture retention and nutrient balance.



COMPOST AMERICA

STATEMENT OF QUALIFICATIONS

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COMPANY HISTORY

Compost Management, Inc. d/b/a Compost America has accumulated more technical experience in processing, financing and marketing than any other company in the compost industry. The executives at Compost America began operations in 1979 with an initial mission of marketing sewage sludge compost produced by the City of Philadelphia. Over the years the Company expanded its marketing activities to include the sale of compost from other municipalities and it developed a broad mix of compost based products and specifications.

The acceptance of composted sewage sludge as a practical and economical beneficial reuse product did not happen immediately. In its first two years, the Company's efforts were focused primarily on product research and customer education. During this time, the Company demonstrated that compost improved the growth in a variety of plants and at less cost than traditional soil amendment products. Over the years, the Company successfully cultivated a broad range of compost markets. These ranged from bulk users, such as land reclamation projects, landfill closures, and farms, to low volume markets which paid premium prices, including landscapers, nurseries, golf courses, and other ornamental users. The Company grew to become the leading marketer of compost in the United States.

In the late 1980's the compost industry experienced a major redirection as federal EPA construction grant funds to municipalities for compost plants ended. This change in federal support created a need to develop privately owned and operated composting facilities. Concurrent with this change, the United States EPA initiated actions to ban the ocean dumping of sludge and state legislatures across the United States forced selected organic wastes (including leaves, yard waste and sludge) out of landfills.

In 1990 Compost America expanded the scope of its "corporate mission statement". The Company acquired the ability to design, build, operate and finance the development of composting facilities by hiring experts from various consulting and operational disciplines.

Compost America's efforts are now directed towards developing company owned composting facilities which are designed to process source separated organic waste received from commercial, industrial and municipal waste generators. Compost America offers waste generators the best long term environmentally friendly approach for the disposal of organic wastes. Composting eliminates the growing concerns of corporate waste flow generators regarding trailing liabilities associated with Superfund legislation aimed at cleaning up contaminated landfills. Additionally, Compost America provides for long term stabilization of waste disposal costs by safely converting organic waste into "beneficial reuse" products under long term contracts with its customers. Compost America's service offering coincides with the source separated position embraced virgorously by environmental groups and recommended by state and federal regulatory agencies.

Waste to Resource Concept

The most abundant renewable natural resource in the United States is organic waste. Waste is a natural by-product of human consumption. It also has the potential of creating significant problems unless it is utilized for what it really is - a valuable resource.

Many companies, organizations and municipalities realize that society no longer has the luxury of throwing away organic waste in landfills or incinerators. Both the federal and state governments are mandating strict adherence to costly new non-polluting landfill and mass burn waste disposal procedures. The results of these stringent controls are economic incentives that signficantly favor COMPOSTING.

Key Industry Trends

The waste disposal industry in the United States is rapidly changing. In some areas of the country, most notably on the East Coast, the impact of changes over the past ten (10) years has already been felt with dramatically increased disposal fees rising from $7.00 per ton to $120 per ton in some cases. Other areas, such as the Midwest, are just beginning to see their costs increase. Due to a combination of factors, the waste disposal industry throughout the United States will continue to experience significant changes over the next ten (10) years.

The United States generates approximately two hundred million (200,000,000) tons of solid waste each year. This is double the amount generated thirty (30) years ago. Part of the rise is attributable to an increase in the amount of waste generated per person each day, which grew from 2.7 pounds in 1960 to 3.5 pounds in 1988. The United States Environmental Protection Agency (EPA) estimates that the volume of waste generated each year will continue to increase steadily.

One of the new areas of greatest opportunity is COMPOSTING. Greater than sixty percent (60%) by weight of the waste stream in the United States is organic and can be converted into compost.

Of all the waste generated in the United States, seventy seven percent (77%) is presently dumped in landfills. The remainder is either incinerated (11%), recycled (11%), or composted (1%) (source: EPA). Historically, landfill space has been cheap; however, available landfill space has decreased significantly over the past ten (10) years and will continue to shrink. The number of active landfills in the United States declined from 30,000 in 1976 to less than 6,400 in 1990. The EPA projects that over the next five (5) years, forty percent (40%) of the existing landfills will reach their capacity and eighty percent (80%) of the current total will close within twenty (20) years.

As the number of landfills and the volume of available landfill space continues to decrease, new disposal strategies must emerge. New incinerator plants will not be the solution for a number of reasons. Most importantly, they are difficult to site because of pressures from communities blocking the development of new plants in their areas (the "not-in-my-backyard" syndrome). Also of significance is that incinerators are economically viable only in heavily populated areas where electricity rates are high. This is because a significant percentage of the revenues needed to justify the financing of these plants is derived from the sale of electricity.

Landfill developers face many of the same siting problems that impede the development of new incinerators. Communities do not want to be the home of a dump site. Moreover, during the past few years there has been increasing pressure to prevent existing or new landfills from accepting out-of-state waste, and in many areas, out-of-county waste. A number of states have gone so far as to enact legislation banning the importation of out-of-state waste to landfills.

Interpretation and enforcement of the Clean Water Act, which was passed in 1987, will be handled individually by each state. State regulations resulting from the Clean Water Act are starting to signficantly influence the waste disposal industry. An example of this is in Illinois, where the State adopted new regulations for groundwater monitoring of landfills. Fifty-seven of the 110 active solid waste landfills in the State notified the state EPA that they would be closing earlier than what their remaining capacities would have otherwise allowed because of these regulations.

Throughout the U.S., but principally in the Midwest, new regulations restricting the ability to spread manures, sludges and other organic wastes on farm land are creating new and more costly waste disposal problems for large organic waste generators.

In 1990-91, over 35 states banned yard waste from landfills, forcing this organic material to be brought to compost sites. In addition many commercial, industrial and retail businesses began participating in various recycling programs, for both economic and environmental reasons.

Compounding the problems for waste flow generators are new taxes on waste taken to landfills and incinerators. Many states now impose landfill and incinerator taxes to fund the promotion and developmemt of composting and other beneficial waste disposal options.

The costs of waste disposal will continue to significantly increase throughout the U.S. as the number of landfills continues to diminish. This will occur independent of the changes in available landfill capacity, because not only will the competition among landfills decrease, but costs of transporting waste even further distances to regional dump sites will continue to increase. The cost of developing and operating a new landfill is extremely costly and typically exceeds $40.00 to $50.00 per ton. This cost will not decline. Compounding the problems for waste flow generators are new taxes on waste taken to landfills and incinerators. Many states now impose landfill and incinerator taxes to fund the promotion and development of composting and other beneficial waste disposal options.

THE COMPOSTING PROCESS

Composting is a process whereby organic matter decomposes into a rich humus.

When biodegradable organic waste which has been properly sized and mixed with sufficient moisture and inorganic nutrients is placed in a static pile, a windrow (elongated pile), or inside a specially designed vessel and is agitated, a natural self-heating process occurs. Micro-organisms, mainly bacteria and fungi, grow rapidly on the organics, using them as a food source and thereby decomposing them. Because microbes are not 100% efficient, some of the chemical energy stored in the organics is wasted and released as heat. The composting mass acts as a self-insulater, retaining heat and leading to a significant increase in temperature. Thus, the organic material "self-heats" through the intense metabolic activity of the micro-organisms. Eventually, the readily biodegradable food supply becomes exhausted, growth and heat generation slow down, and the pile cools.

As the composting process continues, the original material becomes less recognizable, although certain structures persist longer than others. The material darkens, acquires a fibrous texture, increases its water holding capacity, and eventually develops the odor characteristics of freshly turned soil. In the end, finished compost bears no resemblance to its raw material organic waste ingredients. The result of composting is pathogen destruction and the production of an environmentally safe humus product.

While composting is a process which occurs naturally, the proper combination of materials and environmental factors must be present to insure the production of quality compost. These variables include, air, water, carbon, nitrogen, agitation and mechanical analysis. An improper balance of these components will lead to the incomplete decomposition of organic matter and the production of "off spec" compost which is harmful to plant life. Properly produced compost, on the other hand, has no harmful effects and is a product which is environmentally beneficial and can be used as a valuable soil amendment.

WHAT CAN BE COMPOSTED

Compost America develops regional facilities which process and compost the following organic wastes produced by commercial, industrial and municipal waste generators:

Supermarket Waste
Yard Waste
Paunch/Pen/Stable Waste
Food Processing Waste
Restaurant Waste
Agricultural Crop Waste
Cardboard and Paper Waste
Wood Waste
Waste Water Sludge

LIST OF SERVICES

Compost America offers specialized waste management and consulting services for its clients. These service offerings include the following:

* DEVELOPMENT OF PRIVATELY OWNED COMPOST SITES
* REGULATORY AND LEGISLATIVE OVERVIEW
* WASTE AUDITS
* LONG TERM WASTE CONTRACTS
* CORPORATE SPONSORED COMPOST SITES
* WASTE CONTAINERS AND TRANSPORTATION
* FACILITY OPERATIONS
* MARKETING SERVICES
* TRANSPORTATION & APPLICATION SERVICES
* ELIMINATION OF TRAILING LIABILITIES
* ENVIRONMENTAL INSURANCE
* ADVERTISING PROGRAMS THAT HIGHLIGHT BENEFICIAL REUSE
* EMPLOYEE COMPLIANCE TRAINING PROGRAMS

Development of Privately Owned Compost Sites

Compost America's site development division provides all of the services required to establish privatized composting facilities to process source separated organic wastes. These sites are owned and operated by Compost America. In order to provide the lowest possible waste disposal costs to its clients, the Company develops regional facilities that accept organic waste from a variety of corporate, institutional and governmental waste generators. The Company is able to offer long term guaranteed waste disposal contracts at predetermined tipping fees. In addition Compost America insures its clients against the risk of trailing liabilities.

The activities of the site development division include:

* Site Selection
* Permitting - Local and State
* Facility Design & Engineering
* Facility Construction
* Flow Contracting - Long Term and Spot
* Operations
* Funding
* Guaranteed End Product Marketing

Regulatory and Legislative Overview

Waste disposal is a highly localized business. As a result, waste generators looking for long term solutions to their waste problems need to be aware of regulations at the local, state and national level. Compost America regularly communicates with state and national officials and, as a result, is knowledgeable of current regulations and future trends in waste disposal markets. Increasingly, developments within the waste disposal industry occur at all government levels.

Due to the rapidly changing environment in many areas of the United States and Canada, many commercial and industrial companies are looking for alternative means of waste disposal. Compost America is able to educate its clients regarding the developments which will affect them and discuss the changes in regulatory requirements. Compost America will arrange joint meetings between the appropriate state and federal regulatory agencies and it's clients so that first hand information regarding regulatory changes can be made available.

Waste Audits

Many companies collect raw data on waste, but do not compile the information in a meaningful format. Much of the accounting and control over this information is decentralized. As a result, corporate decision makers are frequently unaware of their organization's total waste disposal costs and the level of potential trailing liabilities. Due to the rapidly changing waste disposal environment, combined with the increasing expense of environmental cleanup, many companies are experiencing a lack of control over their disposal costs. Uneducated and incorrect decisions can result, and frequently the wrong individuals wind up in control of significant cost items.

In preparation for entering into a long term waste contract with a client, Compost America will perform a waste audit. With this service, a Compost America representative will assist a client in compiling waste data into a meaningful format. The quantities of organic and inorganic waste are broken out by month, the various waste disposal costs are accumulated, and waste disposal practices are identified. This work provides a basis for a comprehensive waste management proposal to the client.

Long Term Waste Contracts

Historically the waste disposal industry has offered only short term contracts to waste generators. Rapid increases in disposal costs, combined with concerns over the likelihood of significant continuing increases, has created the need for companies to gain control over their waste expenses. Companies now need to budget these expenses over periods longer than 12 months.

Compost America will enter into long term contacts (5 to 10 years) with its customers and will offer fixed prices with modest escalators. For large generators of organic waste, these contracts offer a solution to the continuing uncontrollable and unpredictable increase in waste disposal expenses.

Corporate Sponsored Compost Sites

Compost America will develop compost sites in conjunction with one or more of its clients. Under this program Compost America will enter into a long term (i.e., 10 year) waste flow contract with a client which will fund in whole or in part the development activities of a project. This joint participation is mutually advantageous to Compost America and its client(s) for a variety of reasons including:

* the client(s) desire to participate in a project for public relations purposes;
* the client(s) desire to accelerate the development of a compost facility in its region in order to secure a long term solution to its waste disposal problems; and
* local permitting authorities endorse participation in a project by local employers.

For a project sponsor, Compost America will provide a significant discount to the sponsor's waste disposal costs through a long term contract. Compost America can provide a savings of as much as 50% fifty percent of a sponsor's current disposal costs under this program.

Waste Containers and Transportation

Compost America will provide the containers necessary for proper and effective source separation. This service is offered through affiliations with national and local container companies and includes both large compactor containers and smaller "station" containers.

Separate from the container service, Compost America will work with current haulers or negotiate with new haulers to provide the most effective pickup programs for its clients. This is an important service because in virtually every circumstance, the client's hauling pattern will change when the waste is taken to a Compost America site.

Facility Operations

Compost America, directly with its own staff or through one of the nation's leading "contract operations companies", manages each facility. Appropriate procedures and operational guarantees have been developed so as to provide high quality, long term facility's management.

The elements of the facility operations cover the following:

* Waste receiving
* Testing
* Rejection of "off spec" waste
* Process management guarantees
* Odor control
* Ground water control
* Regulatory compliance
* Insurance compliance
* Site Maintenance
* Site Security
* Compost quality monitoring
* Facility tours

Marketing Services

A Professional Approach To Marketing

Market acceptance of composted products requires a hands-on approach which includes professional marketing techniques, extensive field work, laboratory testing, and university research. Compost America has pioneered a hands-on marketing strategy and developed the industry's leading distribution and marketing program.

Compost America has set the standard for beneficial reuse of compost made from organic waste with:

* a decade of compost marketing and consulting experience;
* a successful track record with many compost sites; and
* marketing methods that have been pioneered, refined, and proven.

Compost America's credentials are such that it is now recommended as the number one full service compost marketing company by the majority of industry leaders.

Size of Compost Markets

One question that continues to be asked is: "If large numbers of composting facilities were developed, are the end use markets large enough to absorb all of the compost that would be produced?"

The answer is an unequivocal, "YES!"

Compost America has identified major end use categories and has determined that as long as compost is properly produced, there will be essentially an unlimited demand for compost products. This opinion has been confirmed by independent consultants exploring the same issue.

Over the last decade Compost America has developed its marketing approach to such an extent that it guarantees timely, cost effective results.

Transportation and Application Services

Compost America has developed a **"Transportation and Application Service"** which provides all of the elements necessary to apply and incorporate compost in bulk quantities. In many areas, local contractors are used, further strengthening the bond with the community work force. The service is divided into two separate programs designed to solve specific vegetation problems. In each of the programs, particular emphasis is focused on soil amending and top dressing using compost products. The two major end use categories are:

* Revegetation of Disturbed Lands
* Sports Turf Top Dressing

Revegetation of Disturbed Lands

Disturbed lands include closed landfills, old quarries, strip mines, and large acreage stripped of topsoil. The federal EPA requires that disturbed land be revegetated (i.e., modified to promote plant growth for 20 years). Compost America offers a service of transporting and incorporating finished compost (along with other soil products) into the damaged earth to promote revegetation. This service offering includes the following:

* Agronomic evaluation
* Compost transportation
* Equipment utilization
* Logistics
* Spreading procedures
* Incorporation methods
* Irrigation procedures
* Guaranteed vegetation

Sports Turf Top Dressing

The second type of **Transportation and Application Service** involves transportation and application of various blends of "Topdress" for use on athletic fields, parks and country clubs. This service is valuable to those infrequent users of compost, because Compost America is able to spread the expense of costly equipment over a large user base. The beneficial results of using "Topdress" for these applications include reduced consumption of water and chemical fertilizers.

Elimination of Trailing Liabilities

Compost America's recycling, composting and application services provide clients with the ability and assurance to eliminate future trailing liabilities. Compost America's receiving, testing, processing and marketing procedures along with the inherent safety of composting eliminate those risks associated with landfills and incinerators.

Environmental Insurance

With the passage of the Superfund legislation, many companies pay for their waste disposal twice, once when the waste is originally removed, and again when a landfill site is cleaned up. Cleanup costs of contaminated waste sites are frequently assessed on the basis of a company's ability to pay rather than their contribution to the problem. As a result, large credit worthy organizations pay for the cleanup costs of contaminated landfills even though they may not have contributed to the problem.

Compost America is an innovator in the waste industry by offering environmental liability insurance to its customers. Each of Compost America's sites carries environmental insurance covering cleanup expenses for any contamination occuring at its compost sites. This insurance, which is backed by one of the world's leading insurance carriers, enables Compost America to offer a unique service in the waste disposal industry, guaranteed **"cradle-to-grave protection".**

Advertising Programs that Highlight Beneficial Reuse

The executives of Compost America have sold more compost than any company in the United States. Their efforts were highlighted on the NOVA Science Series, which has aired on the Public Broadcast System for the past 6 years.

Compost America will develop promotional programs with its waste generator clients to enhance the client's local, regional and national image regarding recycling and composting and to further composting as a waste recycling strategy. These programs include compost giveaways, in-store promotions, community action programs, periodical advertisements, and others. Compost America believes that there are sigificant benefits that will accrue to its clients by promoting the concern for the environment through recycling and composting.

Employee Compliance Training Programs

Effective source separation is related to employee motivation and compliance. Compost America has on site programs that are designed to achieve maximum employee participation. The programs include seminars, visits to a composting facility, creation of citizens action groups, use of compost by employees and others.

COMPOST SPECIFICATIONS

Beneficial reuse can only be achieved when the organic waste is consistently converted to "on-spec" compost. Compost America has been the leader in the industry in developing exact compost quality specifications that assure marketing success.

Destruction of Pathogens

Pathogens are found in many organic waste materials including food waste, sewage sludge, municipal solid waste, and other organic wastes. The Federal EPA mandates that composting achieve a minimum temperature of 55 degrees centigrade for three consecutive days. This will result in pathogen destruction and the resulting compost being safe for distribution.

The conclusion from the report prepared by W. D. Burge, FW, N. Cramet, and E. Epstein of the federal EPA, entitled "Destruction of Pathogens By Composting" states:

> "The pathogens in sewage wastewaters are not eliminated by sewage wastewater processes. Many pathogens are sedimented from the water with the solids that become the various types of sewage sludges. Of the processes used to reduce the pathogen content of sewage sludges, composting is the only one that produces a high level of destruction and a well stabilized product".

Germination and Respiration Index

It is becoming increasingly clear that all composts are not alike. Recent research has shown that poorly processed compost seriously reduces seed germination and in some cases totally stops the normal growing process. It will also inhibit normal root extension of young seedlings.

Immature and poorly processed compost is phytotoxic when compared to mature, well aged compost. Researchers have associated high levels of acetic acid and other short chain fatty acids with phytotoxicity of compost. At relatively higher pH values, especially where objectionable odors are present, butyric acid may contribute significantly to the problem. Compost stability should be measured by the use of a respiration procedure.

It is clear that phytotoxicity of compost is closely associated with anerobic conditions. These conditions are present in poor quality compost and exist in isolated zones as a result of incorrect blending and processing.

Mismanaged airflow, excessively high compost piles and imbalanced carbon to nitrogen ratios are also causes of the anaerobic condition.

Whatever the causes of high levels of phytotoxic agents in compost, it is generally agreed that the ultimate test of compost quality involves the effect of compost on plants. It is for this reason that Compost America uses a bioassay procedure for measuring phytotoxicity in compost products.

General Specifications For Compost

1. The compost must meet minimum federal EPA PFRP standards for General Distribution.

2. The compost must meet federal, state and local standards for heavy metal levels for General Distribution.

3. The compost must meet federal, state and local standards for pesticides, PCB's, phenols, petroleum oil, grease and other contaminants.

4. The compost must be processed through a three (3) step approach. The steps are:

    a. An "Active Phase" which assures "PFRP" (processed further to reduce pathogens) and which requires proper initial C/N ratios, bulking agents, aeration and temperature.

    b. A "Curing Phase" which assures compost aging through moisture and agitation.

    c. A "Storage Phase" which assures high quality compost.

5. The Carbon/Nitrogen Ratio (C/N) of the cured compost must not exceed 30/1.

6. If the bulking agent is over 3/8 inch in size, the compost must be screened to meet the specifications for each end-use as defined by customer acceptance.

7. The compost must have a moisture content between 35% and 50%.

8. The chemicals used in any sludge dewatering must be identified and approved in order to ensure that they do not cause the finished compost to be phytotoxic to plants.

9. The compost must have density of 800 pounds to 1,000 pounds per cubic yard.

Odor Test Specifications for Compost

Introduction

Compost that has been correctly processed in the active, curing and storage phases produces a pleasant "earthy humus" odor. Foul and pungent odors are not characteristic of quality compost.

Odor Test Method

1. Place samples of the Compost to be tested in 3 separate plastic bags (5X7), seal and store for 24 hours.

2. Place samples of on spec compost and humus from local woods similarly in bags.

3. Choose 6 test people (all non-smokers): 3 women and 3 men.

4. Prepare a rating sheet for each:

   5=Excellent
   4=Good
   3=Acceptable
   2=Unacceptable
   1=Completely Unacceptable

5. Each test person should first smell a sample of "on-spec" high quality cured compost and humus, and be told that it represents 5=Excellent. They should then be given the samples in various orders to evaluate and rate.

6. If 4 out of 6 test people rate the sample compost with a 2 or less rating, it is considered unacceptable.

Bioassay Specifications for Compost

Introduction

Garden Cress (Lepidium sativum,L.) is sensitive to short-lived organic compounds that are often found in fresh or poorly aerated compost. These compounds prevent seed germination, normal root development, and produce the pungent odor associated with poor quality compost. Cress has been used in a bioassay for identifying composting problems.

Bioassay Test Method:

Compost samples should be dried, screened and further processed, as follows:

1. Weigh 20-grams of the compost sample, add 100 ml water and blend for 10 seconds.
2. Transfer to filter funnel with 100 ml water.
3. Dilute filtrate 1:1 (v/v) with water.
4. Place 3 ml of filtrate on filter paper in 10 cm petri dish.
5. Place 10 seeds of Garden Cress on filter paper.
6. Prepare 5 replications and incubate at 27 degrees centigrade for 48 hours.
7. Read percent germination at 48 hours and 72 hours, calculate relative root length as a % of the control. The control is the germination using filtrate from cured on spec compost.
8. % germination X % root length = Germination Index. This figure should be equal to 90% of the Control Index.

Stability Test Specifications for Compost

Compost America uses the "Tech-Line", "Stability Stress Test" and the "Stability Confirmation Test" to determine the market quality of compost. For information regarding this test call Techline Instruments, a Division of ArTech International, Fond du Lac, Wisconsin 414-922-6973.

FULL SERVICE MARKETING

Compost America markets its compost products through its own marketing division.

Direct Sales

All Compost America marketing personnel have some direct sales responsibilities in addition to their distributor support functions. Compost America believes that success comes only by being in close touch with end use customers and helping to solve their problems. Because the Company's personnel have strong technical backgrounds and years of experience in the various end uses, the Company supports customers and prospective customers throughout the distributor organization.

Distributor Network and Support

In its established markets,Compost America has defined " regional territories", and within them, established a network of Distributors. Distributors are required to:

*Set up top soil outlets;
*Set up blending sites;
*Initiate a program for authorized stocking dealers
*Guarantee to sell a minimum quantity of product;
*Devote personnel, as necessary, specifically to sales;
*Advertise and promote compost through local media and trade shows; and
*Service customers frequently and diligently.

Each new Distributor must spend appropriate time at the Compost America's head office participating in the Company's "Marketing and Training System". Compost America will set up comparable programs in each new area market where the Company develops a compost facility.

Authorized Stocking Dealer Program

Compost America either directly or through its Distributors, services customer orders over one truckload in size. All other orders are filled locally out of the inventory of local Stocking Dealers.

Each of these Dealers is chosen by Compost America and its Distributors based upon location, size, product sales mix, and other criteria.

Authorized Stocking Dealers are required to:

*Maintain an adequate supply of compost
*Display prominently Compost America banners and Point of Purchase materials
*Hold product seminars for their customers
*Attend company sales and product training sessions; and
*Provide the company with a list of its current and potential customers

Marketing Programs

In addition to establishing and managing a sales and distribution organization, a primary role of the marketing division of Compost America is to design and implement marketing programs that sell product. Compost America identifies the largest targets in each marketplace and customizes marketing programs directed towards these users. The following elements are included to a varying degree in each of the marketing programs that the Company designs and implements.

Product Literature

Compost America publishes technical literature on each of its products covering product applications for each end use. Representing years of laboratory, greenhouse, and field testing, this literature contains definitive findings and recommendations concerning product application and mixing.

Direct Mail Advertising and Telemarketing

Compost America makes extensive use of Direct Mail and Telemarketing programs to efficiently contact and qualify end users. Mailing and telephone lists are generated from the Stocking Dealers and Distributors as well as from proprietary sources. These lists are updated regularly.

Mailings are carefully targeted to key product users on a schedule that is tied to a specific event, either a planting season, a trade show, holiday, or some other date. All mailings are followed up by a telemarketing campaign designed to qualify new customers for face-to-face direct sales contact.

Compost America has found that this technique not only saves a tremendous amount of time and effort for the sales force, but it actually generates phone sales. All marketing programs

embody some variation of a direct mail/telemarketing/sales call strategy.

Trade Journal Advertising

Compost America participates in advertising programs both individually and jointly with distributors.

Seminars

Compost America makes presentations to the following groups:

Flower and Garden Clubs
Soil Conservation Service
County Agents
High Schools
Universities
Church Groups
Arboretums

Through these seminars potential users of compost are exposed to the product.

Customer Service

Compost America has installed toll free telephone service to better serve customers and clients across the country. We can be reached Monday through Friday 9:00 a.m. to 5:00 p.m. E.S.T. at:

1-800-COMPOST
or
1-215-348-9788

1-215-348-7183 (fax)

PRODUCT LINE

Compost

All products produced by Compost America are transformed into a high quality, environmentally safe, EPA approved soil amendment.

Each facility manufactures compost under a stringent set of procedures which are established and monitored by Compost America and the federal and state regulatory agencies. This assures that every customer receives the cleanest, safest product available. Any compost marketed by Compost America must meet company standards for nutrient content, phytotoxicity, physical integrity, pH and consistency.

The important agronomic specifications of compost are consistent and include the following:

*High organic matter content
*EPA approved pathogen destruction
*Consistent pH (5.6-7.4)
*Rich source of Micronutrients (Fe,Mn,S,Zn,Ni,Cu,K,etc.)
*1%-2% Nitrogen and Phosphorus content

Compost is used to amend soil before planting grass seed, shrubs, sod, flowers or trees. Compost adds needed organic matter to the soil and helps soil retain moisture, yet at the same time it promotes good drainage. Compost improves soil cation exchange capacity, enabling soil to better hold on to nutrients. Because compost contains a sufficient supply of micronutrients, there is no need for the user to purchase costly supplements as an additive to commercial fertilizer. Tests prove that plants, trees, shrubs and turf grown in compost amended soil develop thicker, stronger, and more active root systems in a much shorter period of time.

NORRISTOWN AREA SCHOOL DISTRICT
NORRITOWN, PA.

UNIVERSITY OF PENNSYLVANIA
PHILADELPHIA, PA.

RED CLAY CONS. SCHOOL DISTRICT
WILMINGTON, PA.

SMYRNA SCHOOL DISTRICT
SMYRNA, DE.

SWARTHMORE COLLEGE
SWARTHMORE, PA.

UNIONVILLE-CHADDSFORD DISTRICT
UNIONVILLE, PA.

URSINUS COLLEGE
COLLEGEVILLE, PA.

BETHLEHEM SCHOOL DISTRICT
BETHLEHEM, PA.

CATASAQUA SCHOOL DISTRICT
CATASAQUA, PA.

UNIVERSITY OF DELAWARE
NEWARK, DE.

DOWNINGTOWN SCHOOL DISTRICT
DOWNINGTOWN, PA.

MILLERSVILLE UNIVERSITY
MILLERSVILLE, PA.

MUHLENBERG UNIVERSITY
ALLENTOWN, PA.

UNIVERSITY OF SCRANTON
SCRANTON, PA.

SPRINGFIELD SCHOOL DISTRICT
SPRINGFIELD, PA.

TEMPLE UNIVERSITY
PHILADELPHIA, PA.

UPPER DUBLIN SCHOOL DISTRICT
FORT WASHINGTON, PA.

WEST CHESTER AREA SCH. DST.
WEST CHESTER, PA.

OTHER SPORTS TURF USERS

PHILADELPHIA EAGLES
PRACTICE FIELD

GARDEN STATE AND PHILADELPHIA
PARK RACING TRACKS

U S NAVY-PHILA. NAVY YARD

APPENDIX

COMPOST AMERICA - GENERAL INFORMATION
BENEFICIAL USES OF RECYCLED ORGANIC WASTE

BENEFICIAL USES

OF

RECYCLED ORGANIC WASTE

EarthLife®
Sales Company

4140 Skyron Drive

Doylestown, Pa. 18901

WHAT IS ORGANIC RECYCLING?

The recycling of all kinds of waste is certainly one of the most publicized issues in the United States today. The most recent and frequently overlooked waste issue to be addressed is organic waste. Glass, metals and paper were relatively easy waste items to separate and recycle. Yet, organic waste such as sludge, food and yard waste can account for up to 60% of what we dispose of in landfills. All of this organic waste can be converted into beneficial compost useful to everyone from the landscaper to the farmer to the home gardener.

Cities such as Philadelphia, Baltimore and Washington D.C. have been composting sludge for many years. Pennsylvania, New York and New Jersey have all either passed legislation or have legislation pending banning yard waste from landfills. The only current solution available to these states is composting. The compost that is produced, however, must be utilized in order for recycling to be complete. This requires educating all the potential users of compost about it's safety and benefits. This booklet contains information about many of the uses of composted organic waste. More detailed, technical information is available by request.

WHAT ARE THE USES OF COMPOST?

There is really only one use for composted organic matter - SOIL CONDITIONING. Millions of tons of organic matter are lost each year through erosion alone. Parts of the mid-west farm belt, considered by many to be our most productive farmland, have lost most of its organic matter, depending on huge quantities of chemical fertilizer to support crop growth. The situation is worse in our over developed east coast states. The addition of recycled organic waste, properly composted, can reverse this situation.

The addition of compost to any soil type, from sand to dense red clay, will add life back to the soil. It will break up heavy clay soils. It will add water holding capacity to sandy soil. It will improve the soils ability to "hold" nutrients and allow plants easier access to these essential elements. Compost can help soil maintain a neutral pH. Properly conditioned soil is soil that contains the correct balance of air and water. Compost helps provide this balance.

The use of compost is not a magic answer to all the soil problems we face, but it will make a significant improvement to the physical and chemical characteristics of any soil type and it is a proven solution to the organic waste problem facing our country.

WHERE CAN COMPOST BE USED?

Compost can be successful in just about any soil conditioning application imaginable. A few of the more popular uses are:

- General Landscape
- Agriculture
- Athletic Field Construction
- Sand & Gravel Quarry Revegetation
- Golf Course Construction & Maintenance
- Home Gardening
- Topsoil Production
- Greenhouse Mixes
- Landfill Reclamation
- Nursery Production
- Highway Projects
- Sod Production

Composting is the only currently viable means of organic recycling. The compost must be used however, for true recycling to occur. The following pages will introduce you to some of these uses.

IMPORTANCE OF ORGANIC AMENDMENTS IN LANDSCAPING

by Francis R. Gouin, PhD

Introduction

When landscaping there is a time and a place for adding organic matter and there are other times when adding organic matter may not be necessary. When you are transplanting into a good agricultural soil that is already rich in organic matter and is not compacted, the addition of organic amendments may have little value other than giving the roots of the new transplants a faster start and hastening the establishment of new roots. The use of organic amendments, under such conditions, may be questionable.

Transplanting into poor and/or compacted soils and back-filling with an organic matter or soil mix surrounding the root ball or roots is not the most effective use of the organic product. Simply adding a few shovels full of organic matter around the rootballs of plants will only prolong the life of the new plant for a few years. Because the roots of plants do not readily grow in poor and compacted soils, they will remain primarily in the confines of the planting hole, becoming "potbound" and stagnant. When roots are no longer able to grow, the tops of plants decline in vigor and often plants die gradually. Watering and fertilizing cannot correct this type of situation.

Most ornamental or environmental plants are planted to improve the appearance of landscapes and to grow to maturity. The roots of plants that have been properly transplanted in optimum soil conditions, under proper growing conditions, will extend far beyond the diameter of the planting hole within a few months. In fact the roots of all plants extend far beyond the drip line of their branches within a few years after being transplanted under optimum soil conditions. The radius of a root spread from a tree is equal to one to one and one-half the height of the tree or shrub. Therefore, the roots of plants are not confined to the immediate area surrounding the stem. Also, 90% of the roots, of even the largest trees, can be found in the upper 10 inches of soil.

Using Compost To Improve Biologically "Dead" And Compacted Soils

A biologically dead soil consists primarily of sub-soil or soils that contain toxins such as herbicides or industrial waste materials or that may be very acid or alkaline. In many instances biologically dead soils do not contain organic matter. Most common weeds are more tolerant to adverse soil conditions than are most species of ornamentals. Therefore, one should be suspicious that bare or sparsely vegetated ground is "dead" soil.

It has long been recommended to plant ornamentals in deep, rich organic soils. The value of soil organic matter for the growing of horticultural crops has long been recognized. Under "dead" soil conditions, the entire area should be tested to help establish a cause. Compost should be applied and thoroughly incorporated into the upper 6" to 8" of soil. Furthermore, if the soil is compacted, "hard as brick", the land should be treated with a "sub-soiler" or "chisel-plow" to a depth of 18" to three feet and at 18" to 24" intervals, when the soil is dry.

For maximum effectiveness, sub-soiling should be done after the compost has been applied so that some of the compost can penetrate deeper. Subsoiling or chisel plowing when the soil is dry will fracture the fragipan layer that forms as a result of compaction just beneath the soil surface, thus allowing air, water and roots to penetrate deeper and improve drainage. The compost that finds its way deep into the soil will also help loosen the soil and encourage deep penetration of roots especially during periods of drought. Sub-soiling or chisel-plowing up and down the slope will also improve drainage by creating channels in which water can move downhill.

Improving biologically dead or compacted soils requires a minimum of 100 tons (approximately 200 cubic yards) of compost per acre. Uniform application and thorough incorporation is important. Also the amount of limestone or sulfur needed to adjust the pH of the soil must be calculated and added at this time especially if the pH of the soil is at either extremes.

Unless the soils that you are planting in can satisfy minimum plant needs, digging a $10 hole for a $2 plant is a waste of time, effort and money. A $10 hole dug into a sterile, very acid, alkaline, compacted or biologically dead soil may become a miniature dry well and an exercise in futility. Such a practice is a "band-aid" approach that will not serve as a lasting example of a professional landscapers talent. Do it right the first time. Amend the entire planting area with compost when the soil conditions dictate!

Using Compost To Its Maximum In Landscaping

Most forms of construction, ie. buildings, roads and parks, causes severe damage to soils. Heavy equipment compacts and destroys soil structure, especially when it is wet. Often in construction the top soil is removed and sold leaving only subsoil, and in many cases "dead soil", in which plants must be grown. If ornamental plants are to thrive in such conditions the soil in the entire area musts be improved to a depth sufficient to support plant growth.

Compost will help to loosen heavy and/or compacted soils and improve the water holding capacity of sandy soils. Because most of the nutrients in compost are in an organic form, they will be available to the roots of plants for a long period of time. Compost will also provide beneficial micro-organisms that are essential for the degradation of organic materials and for the release of nutrients. Once a biological cycle has been re-established in a disturbed soil, plants are better able to grow to maturity with fewer difficulties.

Therefore, if the soil is too poor to grow even a thriving weed population, it is best to improve the soil over the entire area by not only amending the soil with organic matter but, where indicated, by sub-soiling to eliminate soil compaction and to improve aeration and drainage. Simply placing good soil around the roots of the tree, shrub, vine or flowers being planted in "dead" compacted soils will only provide short lived temporary results.

For information and reprints, contact:

EARTHLIFE Sales Company Doylestown, PA 18901 (215) 348-9288

EarthLife

FOR THE LANDSCAPE CONTRACTOR

TURF

a. Starting new lawns and patching bare spots: Apply a 2" layer to soil and till to a depth of 6", add seed, then rake and water well.

b. Annual maintenance: Apply a ½" layer of EARTHLIFE to lawn, then rake and water well. (Add seed prior to raking if needed).

RAISED AND ROOFTOP PLANTERS (By volume)

Mix 1/3 EARTHLIFE with 1/3 peat moss or milled pine with 1/3 sand or styrofoam.

TOP SOIL MANUFACTURING

Incorporate a 2" to 3" layer of EARTHLIFE into the existing subsoil to a depth of 6". To upgrade existing topsoils, apply a 1"-2" layer of EARTHLIFE and incorporate it to a depth of 6".

TOP DRESSING

Apply a ½" layer of EARTHLIFE to existing turf areas and mat. For best results, aerate and vertiseed.

POTTING MIXES (By volume)

1. Mix 1/3 EARTHLIFE with:
1/3 peat moss
1/3 perlite, vermiculite or sand
or

2. Mix 1/3 EARTHLIFE with 2/3 commercial potting soil. Plant, water thoroughly and **do not** feed for 2-3 weeks.

MULCHING

Spread a 2" layer of EARTHLIFE around trees, shrubs and flowers.

FLOWER BEDS

Add a 2" layer of EARTHLIFE to the soil and till to a depth of 6". Condition soil this way every other year.

TREES AND SHRUBS

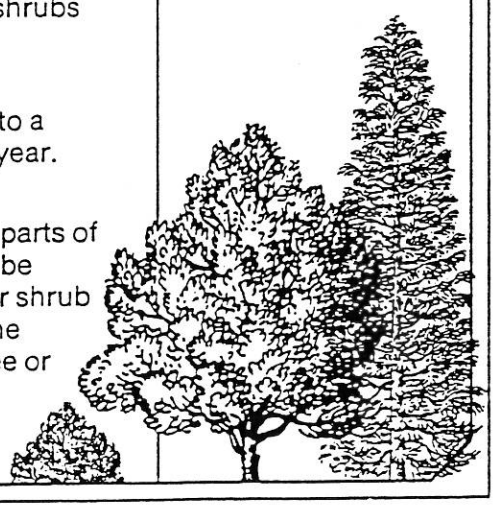
Mix one part EARTHLIFE (by volume) with two parts of soil obtained from hole where tree or shrub will be planted. Place 6" of this mix in hole. Plant tree or shrub and backfill with remainder of mix. Make sure the planting hole is at least two times larger than tree or shrub ball.

Registered with:
NJ DOA, NY DOA, MD DOA, DEL DOA, PA DOA.

Approved by:
NJ DEP, NJ DOT, US DOA, PA DOT, DEL DOT, NJ Turnpike.

Tested by:
- Universities of Penn State, Cornell, Maryland, Rutgers, Delaware.

EARTHLIFE has many different uses for the landscape contractor.



Are you still specifying top soil or peat humus for soil amendments?

SPECIFY EarthLife® INSTEAD

Makes a high quality, low cost soil

- EarthLife establishes better growth in less time.
- It improves physical characteristics of the soil such as water holding capacity, drainage, and friability.
- It increases the organic matter content of the soil.
- It adds both macro and essential micronutrients not found in most commercial fertilizers.
- It helps stabilize pH of the soil (EarthLife has a pH of 6.6 - 7.5).
- EarthLife can do all this at lower cost than either top soil or peat humus!

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- Garden State and Philadelphia Park Race Tracks (Turf Tracks)
- Philadelphia Eagles Practice Field
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- Showboat Hotel & Casino
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Tested and approved

- PA, NJ, MD, and DE Department of Transportation Approved
- University tested at Rutgers, Penn State, U. of Delaware, U. of Maryland, Cornell
- Dept. of Agriculture and EPA registered with PA, NJ, DE, MD, and NY.

Allow us to present the full EarthLife story at your next meeting. Slide presentations can be tailored to fit the time limitations of your schedule. Call now, it will be well worth your time!

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354 North Main Street
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CALL 1-800-EARTHLIFE

TOPDRESSING FOR LAWNS, GOLF COURSES AND ATHLETIC FIELDS

Dr. W. H. Mitchell-Emeritus Professor
Plant Science Department
University of Delaware

Humus-type municipal waste products can play an important role in newly developed turfgrass management programs. Home lawns, corporate grounds, golf courses, sod farms, and athletic fields are just some of the places where composted waste products have great potential for turfgrass improvement.

Research at the University of Delaware has shown that humus/compost can be used to 1) modify poor soil, 2) improve the production of cultivated sod, 3) topdress turfgrass areas in preparation for overseeding, 4) topdress golf greens to smooth the playing surface and suppress thatch and 5) to repair divot damage to tees and fairways. Humus/compost added to the soil will not correct all turfgrass production problems, but it will encourage deeper rooting and make soil moisture more available to the grass. This, in turn, will help the grass to withstand summer heat and drought. It can be an important first step toward producing a more vigorous and stress tolerant grass. Suggestions for specific ways to use humus/compost will follow, but first let's describe the production process.

HUMUS PRODUCED BY COMPOSTING SLUDGE All properly treated municipal sludge is first anaerobically digested and then water is removed by pressing or centerfuging. Compost is then made by mixing 2 parts wood chips and 1 part dewatered sludge cake, on a volume basis. The mixture is then placed in piles 100 feet long, 15 feet wide and 12 feet high. A loop of four inch perforated plastic pipe is placed in the pile and connected to a blower. Air is periodically drawn through the pile to raise the temperature of the compost and hasten the drying process. To assure that pathogens will be killed, temperatures in the compost pile are maintained at 140° F, or higher, for a period of at least 48 hours. The composting process lasts 21 days after which the piles are dismantled and the humus stored for 30 to 60 days for curing and further drying. The humus is then shredded and screened to facilitate handling and recovery of wood chips. It's now ready for use in turfgrass management programs. The locally available product is called, Earthlife.

HOW TO IMPROVE A POOR SOIL Your objective should be to loosen and aerify the soil by the incorporation of humus/compost. This assumes that you are short of rich topsoil and are working with hard, compacted poorly drained subsoil. This will range in color from reddish-orange to gray and it will almost always be slippery or greasy when wet. It creates a hostile environment for grass roots and when it dries out it's almost as hard as concrete. Start the soil improvement process before planting. Apply a three inch layer of humus/compost and thoroughly mix with the soil to a depth of at least 6 inches. A roto tiller will fluff up the soil and give the impression that it's worked deeper than it really is. You may be deceived, so examine the soil carefully to make certain that at least 3 or 4 inches of the compacted subsoil has been mixed with the humus/compost. In most cases, the humus/compost will have a p^H of about 6.5 and will contain the plant nutrients needed for turfgrass establishment. Additional lime and fertilizer will not be needed at planting but should be used as regular maintenance applications. Now the newly modified soil is ready for smoothing, firming and seeding with adapted grasses. If grass is already established, the soil can be improved, although more slowly, by working from the top. This is best done by combining surface applications of humus with mechanical aerification. An aerifier, or coring machinery is used to remove plugs of soil to a depth of 2 to 3 inches prior to applying humus/compost. Humus/compost is then uniformly broadcast to a depth of about 1/2 inch. Some will fall, wash or be dropped into the aerification holes and the root-deepening process will begin. With repeated annual aerification and topdressing a compacted, infertile soil can be made rich and productive.

TOPDRESS WITH HUMUS/COMPOST BEFORE OVERSEEDING There is often a need to thicken up a lawn or turf area by adding new seed. To be successful, there must be good seed-soil contact. Without this, seed will fail to germinate and the effort will be a waste of seed and money. Humus/compost is an excellent growth medium for the germination of seed. It is equally effective for larger turf areas and for small "patch up" jobs on home lawns. Humus/compost can be uniformly spread to a depth of 1/2 inch and followed by over-seeding using seed of grasses that predominate in the area being renovated. An excellent choice for patch-up work, however, is fine textured perennial ryegrass of which there are several well adapted varieties. The seed can be mixed with the humus/compost by light raking or by watering. Green-up will begin in about 2 weeks following seeding.

Another system that works well is to mix the seed and humus together before spreading it over the area to be renovated. Pre-mixing will hasten the germination process and result in faster green-up. As a general rule, seed should be mixed with humus/compost and stored in a pile for about 5 days prior to topdressing.

CUT PRODUCTION TIME AND SOD WEIGHT BY ADDING HUMUS Producing cultivated sod is a slow process, taking as much as 18 months from seeding to harvest. It may be necessary to mow the grass 40 or more times before it is lifted and sold. Heavy traffic such as this can cause compaction and cut the productivity of sod fields. Tests have shown that humus/compost, worked into the soil prior to seeding, will loosen the soil and cause grass to develop more rapidly. Furthermore, this is one way to replace the 1/3 to 1/2 inch of topsoil that is removed from a field each time sod is harvested. An added bonus is the approximate 25% reduction in sod weight that results from adding humus/compost to the production programs. Here is good procedure to follow: Using a manure spreader uniformly spread 2 inches of humus/compost over the prepared seed bed. Disk this into the top 2 to 3 inches of soil prior to seeding. Placed close to the soil surface, humus/compost will improve growth, reduce compaction of surface soil and cut the weight of harvested sod.

TOP DRESSING GOLF GREENS With several topdress mixtures on the market or being formulated by do-it-yourselfers why do we need another one? Because we are always striving for something better. Research has shown that a 50-50 mixture (V/V) of locally produced humus/compost and the highest quality sand available makes an excellent topdressing mixture. Water will percolate through this mixture at a rate in excess of 10 inches per hour. Therefore, when used as a topdressing, it will not impede drainage. The sand used in the mixture has been carefully screened with 97% of the particles ranging in size from 0.2 to 1.0 mm. There is a significant amount of nitrogen in the humus/compost but tests have shown that only about 10% becomes available annually. At this rate, it will not significantly stimulate grass growth although it may produce some improvement in color. There is no evidence that repeated use will in any way restrict rooting or cause the development of a moisture barrier. This mixture can also be used for divot repair on tees and for the repair of damaged areas in heavily used athletic fields.

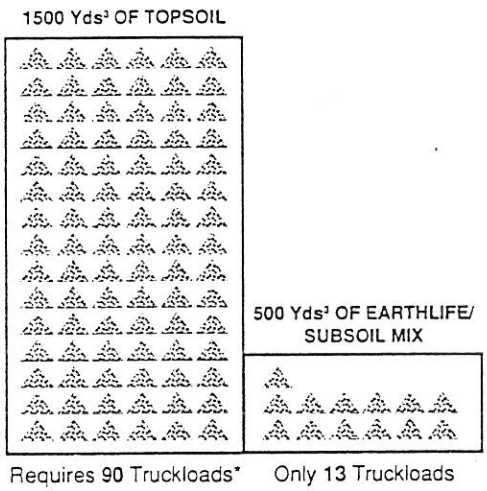
For more information call:

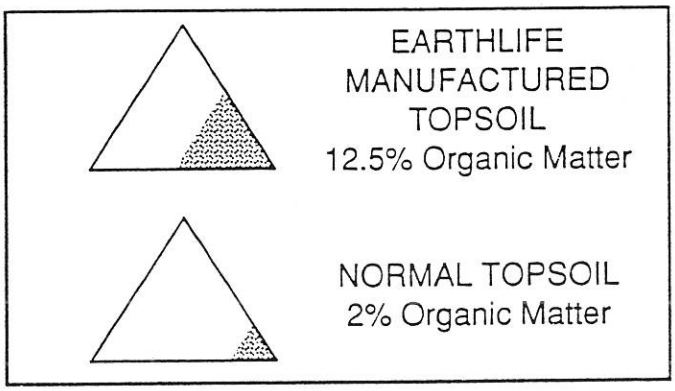
MANUFACTURE LOW COST, HIGH QUALITY TOPSOIL ON YOUR SITE WITH

EarthLife

Reduce Your Costs– Make Your Own Topsoil On-Site
Turn Subsoil & Sand Into Fertile Topsoil!

NORMAL TOPSOIL VS. EARTHLIFE TOPSOIL





* Based on 2400 lbs. per Yd³ of soil.

If you use commercially available topsoil...

Is your topsoil consistent from load to load?
Does it have a neutral pH?
Is it free from weeds?
Is it rich in organic matter?

Using EarthLife to "manufacture" your own topsoil on-site has many advantages over purchasing commercially available topsoil. **EarthLife Topsoil**...

1) Substantially reduces your topsoil cost.
2) Is rich in composted organic matter.
3) Contains macro and micro nutrients essential for plant establishment and growth.
4) Has a higher moisture holding capacity than most natural soils.
5) Is easy to work with.
6) Has better ion exchange capacity.
7) Promotes deeper, more extensive rooting systems.
8) Has a neutral pH.
9) Is free of weed seeds, stones, herbicides, and insecticides.
10) **EARTHLIFE TOPSOIL** IS CONSISTENT- EVERY TRUCKLOAD IS THE SAME!

There are many users who have significant requirements for pre-mixed products blended from straight compost. Mixes may be blended at various blend sites. All blends are produced to exacting specifications, and samples are taken regularly and analyzed to ensure that standards are maintained.

Topsoil

Compost, combined with the proper grade of sand, produces a manufactured topsoil of exceptional quality and consistency at a cost that is less than most commercially available topsoils. While high quality natural topsoil has become difficult, if not impossible to find, virtually unlimited quantitites of manufactured Topsoil may be produced with compost.

Tee Construction Mix

Golf courses are a signficant user of organic soil amendments. Golf tees are the most heavily used area of a course. Wear on tees is often reduced by expanding the tee area. Tee Construction Mix is a growth medium designed specifically for golf tees which produces thick growth, deep rooting, and stress tolerance. Tee Construction Mix provides good aeration, which speeds root growth, and fosters increased nutrient retention. It allows golf course superintendents to construct and seed earlier in the Spring and later in the Fall. The darker colored mix warms up faster and stays warmer longer than mineral soil. Weed free, Tee Construction Mix contains micronutrients and secondary elements in its humus base that reduces the need for addtional fertilizer.

Green Topdress Mix

Since golf course greens are cut to low levels at high frequency, green maintenance generally requires a regular program of aeration and thatch control. Green Topdress Mix is a combination of high quality sand and humus, which produces rapid percolation and aeration required for good root growth. For this reason it will not produce a moisture barrier that can restrict rooting and lead to "Black Layer". In addition, the mix will minimize thatch, reduce compaction, smooth the surface, and reduce surface drainage.

Professional Grower Mixes

Professional growers save money and grow better, healthier plants by incorporating compost into potting mixes and planting soil. Growers of bedding plants and cell plants such as Petunia, Marigold, Ageratum, Impatiens, etc. incorporate compost with their Peat and Vermiculite mixes and save over 50% on mix costs during an eight week growing period. Similarly, growers of Chrysanthemums and Poinsettias often mix compost with peat and sand.

Growers of field crops incorporate compost into the top six inches of soil to replace organic material removed during each growing season. By doing so they increase acreage productivity by up to 25% and save hundreds of dollars per acre in fertilizer costs, reduce winter injury and minimize irrigation needs in areas with sandy soils.

Customer Base

Compost products are marketed to a diversified customer base. Much time, effort, and money has been expended in developing end uses. The major categories of end users and a description of some high visibility projects follow:

20 Major End Use Categories

*Greenhouse Growing
*Container Growing
*Field Growing
*Landfill Reclamation
*Golf Course Construction and Maintenance
*Corporate Lawn Construction and Maintenance
*Cemetery Construction and Maintenance
*Athletic Field Construction and Maintenance
*Home Gardening and Growing
*General Agriculture
*Sod Growing
*Race Track Construction and Maintenance
*Export
*Highway/Roadside Construction and Maintenance
*Strip Mining Reclamation
*Desert/Seashore Reclamation
*General Landscape Construction and Maintenance

*Park Construction and Maintenance
*Airport Construction and Maintenance
*General Land Reclamation

High Profile Projects

In the past few years compost has been used in a number of high profile projects, demonstrating the diversity of markets Compost America has been able to successfully penetrate.

Trump Castle Hotel and Casino

Approximately 85 truckloads of compost container mix were delivered to the Atlantic City job site for use in the construction of all their raised planters. The site was awarded the 1986 A.S.L.A. Merit Award for successful landscaping. Also in Atlantic City compost and compost mixes were used in landscaping the Showboat Hotel and Casino and Harrah's Marina Hotel and Casino.

Garden State Park/Philadelphia Park

These were the first and perhaps most well known large scale projects. Thousands of yards of compost mixed with sand were used to construct the turf tracks one mile long by 90 feet wide.

Moccasin Run Golf Course

Compost Tee Construction Mix was used to build all 18 tees and greens. In addition, straight compost was used to construct several fairways.

Liberty State Park

On a six acre site on the New Jersey side of the Hudson River across from the Statue of Liberty, approximately 1400 CU YD's of compost were used to amend the base soil prior to sod planting. Plans are in progress for development of the remaining 250 adjacent acres.

COMPOST END USERS

THE FOLLOWING IS A PARTIAL LIST OF END USERS WHO HAVE PURCHASED AND USED COMPOST.

Golf Courses

ATLANTIC CITY CC
BECKETT CC
BRIGANTINE CC
BUENA VISTA CC
BURLINGTON CC
COHANZICK CC
CONCORDIA CC
EAGLES NEST CC
FREEWAY CC
GOLDEN PHEASANT CC
GREEN TREE GOLF COURSE
GREEN ACRES CC
GREENS AT DELRAN
HANOVER CC
LAKEWOOD CC
LINKS AT KINGS GRANT
LITTLE MILL CC
MARRIOT-SEAVIEW CC
MEDFORD LAKES CC
MEDFORD VILLAGE CC
MERCHANTVILLE CC
OCEAN ACRES CC
PENNSAUKEN GC
RAMBLEWOOD CC
SALEM CC
SANDS CC
SPRINGFIELD GOLF CENTER
STONE HARBOR GC
TOMS RIVER CC
TRENTON CC
WEDGEWOOD CC
WOODBURY CC
WILDWOOD CC
WILLOWBROOK CC

Growers

LA ROSA GREENHOUSES
WOODBURY, NEW JERSEY

OVERDEVEST NURSERIES
BRIDGETON, NEW JERSEY

GEERLINGS NURSERIES
PISCSATAWAY, NEW JERSEY

BOCKER'S GREENHOUSES
VINELAND, NEW JERSEY

MICHAEL'S NURSERIES
MEDFORD, NEW JERSEY

Athletic Fields

PAULSBORO SCHOOL DISTRICT
PAULSBORO, NEW JERSEY

PENNSAUKEN SCHOOL DISTRICT
PENNSAUKEN, NEW JERSEY

OCEAN COUNTY PARK SYSTEM
TOMS RIVER, NEW JERSEY

PHILADELPHIA EAGLES PRACTICE FIELD
PHILADELPHIA, PA.

GARDEN STATE RACE TRACK
CHERRY HILL, NEW JERSEY

KEYSTONE RACE TRACK
BENSALEM, PA.

JEFFERSON TWP. PARKS DEPARTMENT
MORRIS COUNTY, NEW JERSEY

JACKSON SCHOOL DISTRICT
JACKSON, NEW JERSEY

CHATHAM SCHOOL DISTRICT
CHATHAM, NEW JERSEY

DELAWARE VALLEY COLLEGE
DOYLESTOWN, PA.

MORAVIAN COLLEGE
BETHLEHEM, PA.

BRIDGEWATER SCHOOL DISTRICT
BRIDGEWATER, NEW JERSEY

NORTH BRUNSWICK SCHOOL DISTRICT
NORTH BRUNSWICK, NEW JERSEY

LAWRENCEVILLE SCHOOL
LAWRENCEVILLE, NEW JERSEY

DOVER SCHOOL DISTRICT
DOVER, NEW JERSEY

MCDONALD'S COMMUNITY

OUTREACH PROGRAM
NEWARK, NEW JERSEY

ABINGTON SCHOOL DISTRICT
ABINGTON, PA.

BOYERTOWN AREA SCHOOL DISTRICT
BOYERTOWN, PA.

CHRISTIANA SCHOOL DISTRICT
NEWARK, DE.

LEHIGH UNIVERSITY
ALLENTOWN, PA.

CLIENTS

TEEPAK, INC.

CITY OF PHILADELPHIA, PENNSYLVANIA

CITY OF SCRANTON, PENNSYLVANIA

SPRINGETTSBURY TOWNSHIP, PENNSYLVANIA

WASHINGTON, D. C.

MIDDLETOWN TOWNSHIP, NEW JERSEY

BUENA TOWNSHIP, NEW JERSEY

SUSSEX COUNTY, NEW JERSEY

MORRISON KNUDSEN ENGINEERS, INC.

METROPOLITAN WASHINGTON COUNCIL OF GOVERNMENTS

ENVIRONMENTAL RECOVERY SYSTEMS, INC.

FRU CON CORPORATION

BETHLEHEM STEEL

PUBLICATIONS

MANUFACTURE LOW COST, HIGH QUALITY TOPSOIL
COMPOST EASES TOPSOIL SCARCITY
WHAT GRADE OF COMPOST SHOULD I USE?
A HIGH QUALITY TOPSOIL AT 1/2 THE PRICE
ATTENTION: LANDFILL MANAGERS
HOW TO MAKE YOUR OWN TOPSOIL WITH COMPOST
LANDFILL VEGETATION PROCEDURES
COMPOST CONVERSION TABLE
HOW TO SPECIFY COMPOST
COMPOST AVERAGE ANALYSIS
COMPOST TEE CONSTRUCTION MIX/GREEN TOPDRESS MIX
HEAVY METALS OR ESSENTIAL TRACE ELEMENTS?
NATURE'S WAY: HOW WASTEWATER TREATMENT WORKS
COMPOST "WHAT IS IT? WHY SHOULD I USE IT?
ARE YOU PLANNING A LARGE SCALE LANDSCAPING RENOVATION?
ADVANCED TECHNOLOGY HELPS SPORTS TURF MANAGERS
ATHLETIC FIELDS: THE TOTAL RENOVATION PROCESS
ATHLETIC FIELDS: TOPDRESSING AND THATCH CONTROL
FROM WASTE TO LAWN CARE RESOURCES
OVERSEEDING/A PRACTICAL QUICK FIX
PUBLIC SPORTS TURF: DRASTICALLY IN NEED OF STANDARDS
RESOURCEFUL RENOVATION
SPORTS TURF RECOMMENDATIONS
ARE YOUR ATHLETIC FIELDS SAFE?

AGRONOMICS OF SAND IN CONSTRUCTION & TOPDRESSING
GREEN CONSTRUCTION MIX
GREEN TOPDRESS MIX
TEE CONSTRUCTION MIX
GOLF COURSE TEES AND FAIRWAYS TOPDRESSING & THATCH CONTROL
ORGANIC AMENDMENTS TO SOILS
PEAT IN GREENS: KNOWNS, UNKNOWNS AND SPECULATION
SAND-THE BUILDING BLOCK
TEE CONSTRUCTION MIX: CONSTRUCT OR ENLARGE TEES
THATCH MANAGEMENT
TOPDRESSING MIXTURES: THE GREEN SECTIONS POSITION
USGA GREEN SECTION SPECIFICATIONS FOR SOIL MIXTURES USED
GUIDELINES FOR AZALEAS, RHODODENDRONS
GUIDELINES FOR BEDDING PLANTS
GUIDELINES FOR COMMERCIAL ROSE PRODUCTION
GUIDELINES FOR GENERAL NURSERY STOCK
GUIDELINES FOR GROWING & FORCING BULB CROPS
GUIDELINES FOR MIXING & BLENDING
ARE YOU PAYING 50% MORE THAN YOU SHOULD?
COMPOST FOR THE LANDSCAPE CONTRACTOR
HOW TO SPECIFY COMPOST
HOW TO TAKE A SOIL SAMPLE
IMPORTANCE OF ORGANIC AMENDMENTS IN LANDSCAPING

MANUALS

COMPOST MARKETING
A LANDSCAPE MANUAL FOR COMPOST USE
LANDFILL VEGETATION USING COMPOST
GOLF COURSE MANAGEMENT USING COMPOST
A REVIEW OF BULKING AGENTS

Product and Market Development

Specific university research covering each type of customer was initially non-existent; as a result, Compost America participated in a program to fund university product development research. Projects were funded at Penn State, Rutgers, and Cornell Universities in addition to the Universities of Maryland and Delaware.

Although the general agronomic benefits of compost were identified, specific end use recommendations are necessary for each new customer type. Moreover, no two composted waste products are identical or perform in exactly the same way with all plant species. Ongoing university research is, therefore, critical to the success of any marketing program. Compost America has retained leading researchers in the field to provide ongoing university research.

Greenhouse Testing

As each new compost site is constructed, it is important to determine the acceptability of the new compost that is being produced. Following ten years of greenhouse testing, Compost America has developed a Standardized Greenhouse Testing Program which yields data allowing for proper and consistent product development and utilization.

University testing and the creation of regional reference centers is an integral part of all marketing programs undertaken in new geographic areas. The Company's testing programs lead the industry and, by doing so, assure Compost America the leading position in product marketing.

Quality Control

Compost America constantly monitors and tests the quality of both new and existing compost supplies to assure itself and its customers that ITS compost meets or exceeds specification, is of the highest quality, and that the respective technical literature is current and accurate. The Company's phytotoxicity test is becoming the standard of the industry. Adherence to Compost America's detailed compost specifications assures end user acceptance.

The Company's consultants have more than 50 years of compost research and testing experience and assisted Compost America over the last decade in conducting hundreds of greenhouse and field test programs. An integral part of the Company's testing program is in determining the acceptability of different composts for use by a wide variety of customers, making specific recommendations for each end use. Specific formulations, fertilizer programs, and application rates are tested and recommended for different varieties of greenhouse crops, nursery stock, and turfgrasses, as well as their various applications.

Technical Support

An obvious but sometimes overlooked part of Compost America's successful compost marketing program is making sure that compost and mixes are used correctly in the field to assure that the benefits that the Company has attained in the laboratory and the greenhouse can be duplicated at the customer level. The Company provides this technical support through various means.

Personal contact and site visitation are often necessary to confirm the accuracy and suitability of standard recommendations. Often a soil analysis is necessary and a program for product application must be customized. Product samples at up to truckload sizes may be required.

Compost America has developed and made available standard recommendations for application and use of compost. This data base of technical literature, developed from years of research is the most extensive of its kind.

ROGER E. TUTTLE

EDUCATION

Fairleigh Dickinson University 1963
B.A. Economics
Minor, Chemistry and Biology

Fairleigh Dickinson University 1969
Masters in Business Administration
Major, Marketing

PROFESSIONAL MEMBERSHIPS

Board Member - Solid Waste Compost Council
Golf Course Superintendents Association
Water Pollution Control Federation
Nurserymen's Association

Mr. Tuttle is the Chairman of the "Office of the President" of Compost America. He has twelve years experience in compost research and product development and is one of the leaders in the United States in developing marketing programs for the beneficial use of compost. These programs include the use of compost by golf course superintendents, growers, landscapers, and athletic field managers. Mr. Tuttle has been instrumental in developing product specifications for the compost industry and composting procedures for regulatory agencies.

Mr. Tuttle is a founding member of the Solid Waste Composting Council and a member of its current Board of Directors.

Mr. Tuttle is a nationally recognized speaker and has authored or co-authored many important manuals and documents for use by the compost industry. The manuals include:

1. Compost Marketing in the United States
2. Minimum Specifications for Public Acceptance of Compost
3. A Landscape Manual for Compost Use
4. Landfill Vegetation Using Compost
5. Golf Course Management Using Compost
6. A Review of Bulking Agents

JONATHAN W. FRANK

EDUCATION

Trinity College 1974
Bachelor of Arts

University of Pennsylvania
Wharton School of Business
M.B.A.

Mr. Frank is President of the "Office of the President" of Compost America. He joined Compost America in early 1992.

He is responsible for the Site Development Division and for raising required outside financing. Prior to joing the Company in January 1992, Mr. Frank was a member of Compost America's advisory board for eighteen months.

LFC Financial Corp.

As an executive officer of LFC Financial Corp., Mr. Frank originated and closed approximately $500 million of project financing and leasing transactions and was active in other types of financings, including venture capital and corporate financing. During his tenure at LFC, the large privately held investment company grew from a net worth of $25 million to over $300 million.

IBM

After business school, Mr. Frank worked as a marketing representative at IBM for 3 1/2 years. During this time he received national and regional sales recognition awards.

ALFRED A. RATTIE

EDUCATION

Pennsylvania State University 1975
Bachelor of Arts

PROFESSIONAL MEMBERSHIPS

Various Nurserymen's,
Landscape Architects, and
Professional Growers Associations
Solid Waste Composting Council - Marketing Committee

Mr. Rattie is the Executive Vice President and Secretary of the "Office of the President" of Compost America. He has twelve years experience in marketing compost. He participated in developing successful marketing programs for most of the large compost sites throughout the United States.

Mr. Rattie has been one of the leaders in introducing compost to the landscape architect industry, turf and horticulture industry, landscapers and retail stores. Mr. Rattie is a recognized speaker and has co-authored:

1. Compost Marketing in the United States
2. A Landscape Manual for Compost Use
3. Landfill Vegetation Using Compost

KENNETH J. AIANI

EDUCATION

Lafayette College 1983
B.A., Biology, Chemical Engineering 1983

EXPERIENCE

Mr. Aiani is the Vice President of Operations of Compost America. He has 9 years experience in the solid waste industry.

Prior to his current position, Mr. Aiani was Director of Operations for Agripost, Inc. the world's largest indoor municipal Solid Waste Composting firm. He managed full scale facility operations and financial support for Agripost. He was corporate liaison with Florida Department of Environmental Regulation (DER), and Metropolitan Dade County Departments of Solid Waste Management (SWM) and Environmental Resources Management (DERM) including assurance of operational compliance with federal, state and lcoal agency regulations. He established an on-site QA/QC laboratory and testing program to confirm compliance with State Class A compost requirements for unrestricted distribution. Successfully obtained DOT, DER, and DERM product approvals. Directed budget development, process modifications, and product marketing and development.

Prior to Agripost, Mr. Aiani was General Manager of Fairfield Service Company and was responsible for overseeing all aspects of the operation of the FSC-Delaware Reclamation/ Composting Facility, including a $3.5 million annual budget development and disbursement, negotiating contract dispute settlement agreements with prime contractor, etc. Instrumental in development of State sludg e and solid waste composting regulations. Responsibilities included managing operations, maintenance, quality assurance/quality control, product marketing, research and development, administration and accounting.

From 1983 to 1990 Mr. Aiani held several positions at Fairfield Service Company including General Manager, Engineering Manager, Q.A. Laboratory Supervisor and Quality Control Technician.

CHARLES A. BOTSON, CPA

EDUCATION

Messiah College 1979
B.A., Accounting
Continuing Education
PICPA-approved courses in Accounting, Auditing
Taxation, and Management Advisory Services

EXPERIENCE

Mr. Botson is the Assistant Controller of Compost America. He is qualified by three years private and seven years public accounting experience.

Mr. Botson's areas of expertise and experience are as follows:

Financial Statement Preparation
Tax Planning
Financial Projections
General Accounting
Cash Management

Prior to Mr. Botson's present position, he was a consultant for Cooper Computer Systems, Inc. providing accounting support for accounting software customers. He prepared their financial statements and year-end account anaysis for the company's accounting firm-Niessen Dunlap & Pritchard, CPAs.

From 1982 to 1989 Mr. Botson held several positions with Niessen, Dunlap & Pritchard, CPAs as Senior Account Level 1 for 2 years, Staff Accountant Level II for 2 years and Staff Accountant Level 1 for three years.

Prior to positions with Niessen, Dunlap & Pritchard, Mr. Botson was a Staff Accountant for the Reading Company. He prepared financial statements for a coal-processing plant subsidiary. Mr. Botson also participated in measurement of finished product for physical inventory purposes and kept perpetual inventory records.

WILLIAM KISH

EDUCATION

University of Dayton 1978
BS Civil Engineering

LICENSES

Pa Schl Wastewater License
Pa WBI Water License
Ohio Class II Wastewater License, Class III Water Operation License, Class III Water Distribution

EXPERIENCE

Mr. Kish is the Vice President of Site Development and Consulting of Compost America. Prior to his current position he worked for Taylor Packing Company and was directly responsible for .3MGD anerobic/activated sludge wastewater treatment facility, wet scrubber air pollution equipment, potable water, underground storage tanks, Sarah Title III, Community Right-to-Know and composting. He initiated many cost savings programs.

His prior positions included Principal Engineer for C.E. Moore, Environmental Operations Supervisor for Moyer Packing Company, Water and Wastewater Supervisor for the City of Miamisburg, Ohio, Assistant City Manager, Service Director for the City of Trenton, Ohio and Chief Operator for the Butler County Water & Wastewater Division.

ACCOMPLISHMENTS

WPCACP Industrial Safety Award - 1989
"Perkiomen Valley Watershed Industrial Treatment" Award
Member of Water Pollution Control Federation Constitution and Bylaws Committee - 1985-Present
Member of WPCF and AWWA

ROBERT J. LOCOLA

EDUCATION

Fairleigh Dickinson University 1968
B.S. Marketing
University of Michigan-Management Development Program
Celanese Corporation
Management I & II
Finance
Problem Solving

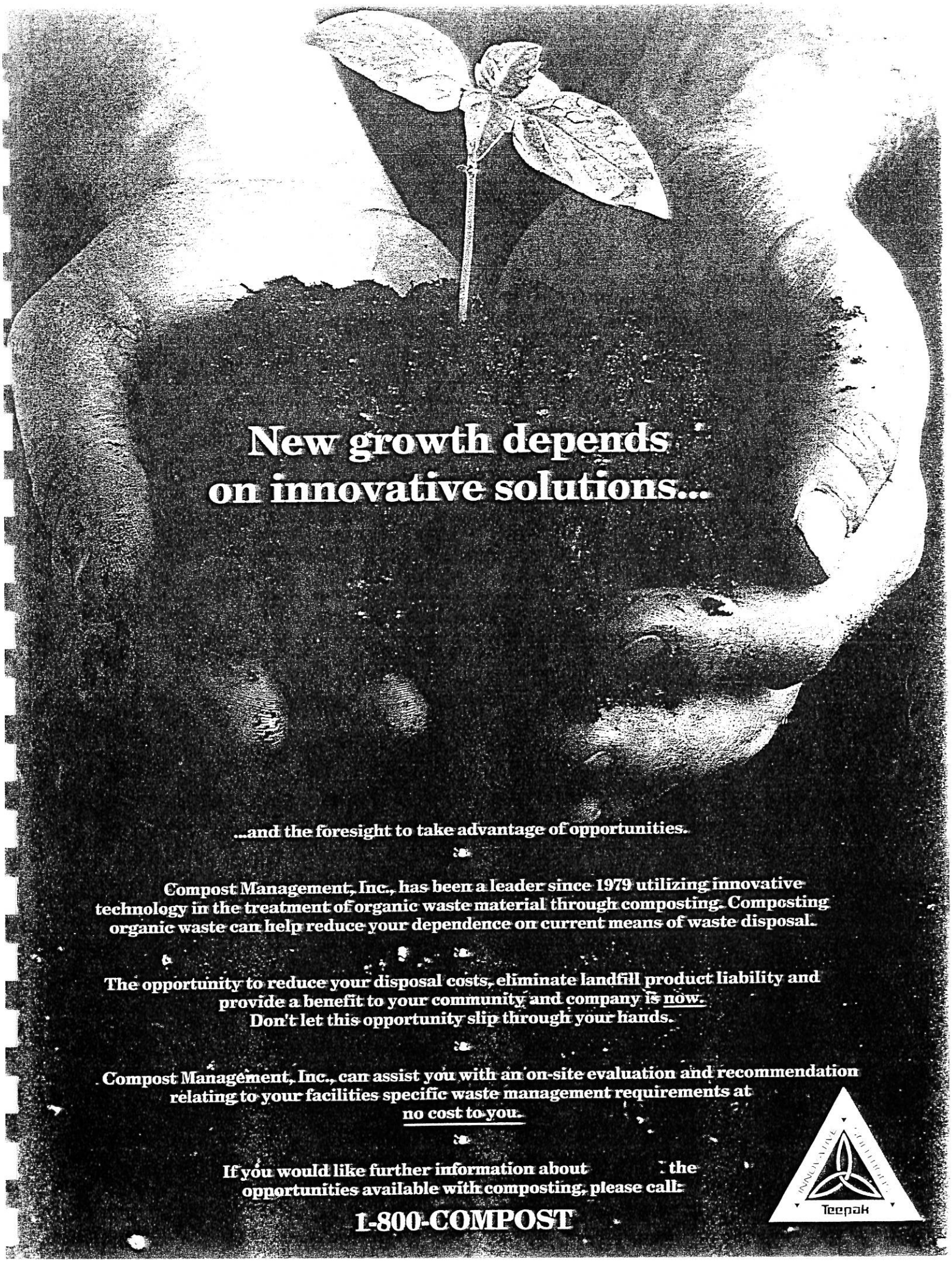
EXPERIENCE

Mr. Locola is the Vice President of Waste Products Procurement of Compost America. His previous position was Marketing Manager, Hoechst Celanese Textile Fibers Group, Hoechst Celanese Corporation. He was responsible for $220MM of sales volume. His previous positions at Celanese were Market Manager, Throwster Markets, Group Manager, Women's Apparel Merchandising, Group Manager, Home Furnishings Markets, National Sales Manager, Fiber fill Markets.

ACHIEVEMENTS AND AWARDS

First Market Manager to receive Hoechst Celanese Quality Management Award

Starting in the mail room, Mr. Locola was promoted through 16 job levels over a 28 year career at Celanese Corporation and Hoechst Celanese.


New growth depends
on innovative solutions...
...and the foresight to take advantage of opportunities.
Compost Management, Inc., has been a leader since 1979 utilizing innovative technology in the treatment of organic waste material through composting. Composting organic waste can help reduce your dependence on current means of waste disposal.
The opportunity to reduce your disposal costs, eliminate landfill product liability and provide a benefit to your community and company is now.
Don't let this opportunity slip through your hands.
Compost Management, Inc., can assist you with an on-site evaluation and recommendation relating to your facilities specific waste management requirements at no cost to you.
If you would like further information about the opportunities available with composting, please call:
1-800-COMPOST
Teepak